

**BLOOD LEAD AND
ASSOCIATED RISK FACTORS
IN ONTARIO CHILDREN, 1984:
SUMMARY AND CONCLUSIONS**

DECEMBER 1985

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BACKGROUND

The harmful effects of lead have been recognized for centuries. Lead poisoning in children has been described in the medical literature since the turn of this century as a "disease of habitation".¹ During the past decade, the suspicion that lead poisoning in children may be related to factors outside the home has received growing attention. The external environment, as well as the home, may now be a significant factor in a child's lead exposure.

Lead in the environment arises from both man-made and natural sources. Lead in food is believed to be a major source of a child's lead body burden. A recent publication of the Federal Government of Canada attributed 65% of the average daily intake of lead in children to dietary sources.² However, more recent studies of Canadian foods suggest that lead levels in food today are significantly lower than they were when the report from the federal government was prepared.³ Lead in air, soil and dust, lifestyle and personal habits are among the other major contributors to the body burden of lead. There is concern

that lead additives in leaded gasoline are a major contributor to environmental air lead in areas without a source of industrial emissions.

Recent efforts in the western world to reduce air lead have been focussed on decreasing the lead in leaded gasoline. Information has been lacking about the effect of present levels of lead in gasoline on the health of Canadian children. There has been a lack of representative data on blood lead levels of Canadian children who are not exposed to a known or suspected source of environmental lead pollution. A number of studies have been conducted in Ontario to test blood lead levels of children living near specific sources of lead emissions. Findings from these studies are limited in applicability by the absence of information on blood lead levels in children who do not live near a lead emission source.

Because of this lack of baseline data, the Ontario Ministries of the Environment, Labour and Health undertook a study of blood lead levels in Ontario children. The study, Blood Lead and Associated Risk Factors in Ontario Children, 1984, was carried out under contract by ARA Consultants (Toronto), working closely with an interministerial, multidisciplinary working group.

OBJECTIVES

The objectives of the study were:

- . to determine the distribution of blood lead concentrations in a selected sample of Ontario children in areas free of known sources of industrial lead emissions
- . to determine if variations in blood lead levels in children conform to any urban-suburban-rural pattern
- . to determine among these children the presence of specific risk factors shown in previous studies to be associated with elevated blood lead concentrations
- . to identify those factors that might be associated with variations of blood lead concentrations in Ontario children

METHODS

This study was designed to measure the blood lead levels of Ontario children six years of age and under in urban (Toronto, Windsor), suburban (Scarborough, Etobicoke) and rural (the vicinity of Longwoods and Nanticoke-Walpole) sites, and to determine the socio-demographic, lifestyle, behavioural and environmental factors that significantly influenced the blood lead levels of these children. Children's blood lead levels are expected to be at their highest following outdoor exposure during summer months. Blood testing was carried out over a six week

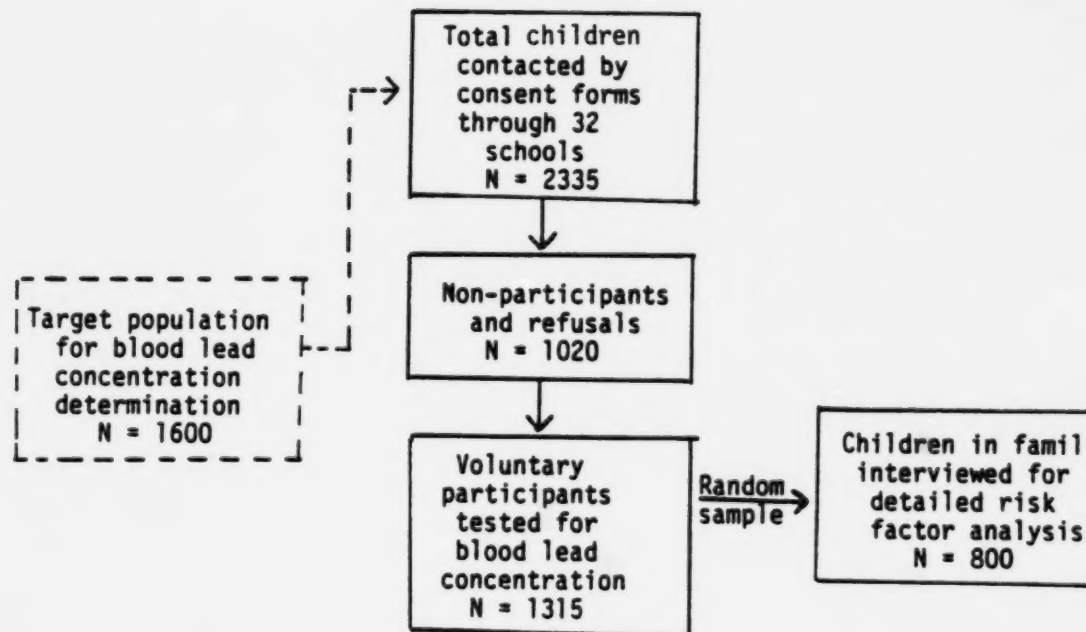
period from the third week of September through mid-November, 1984.

Elementary schools in closest proximity to the Ministry of the Environment's existing air sampler in each site were chosen for recruitment of youngsters to participate in the study; the number of schools varied from four to six per site. A target group of 1,600 children in junior and senior kindergarten and grade one classes in thirty-two schools was identified for blood testing. Parental permission was obtained for each child to participate. A total of 1,315 children, including preschool-aged siblings, were tested for blood lead. From this group, a randomly selected sub-sample of families of 800 was interviewed using a standardized questionnaire. (See Figure 1). The questionnaire was designed to obtain information on potential risk factors for lead exposure, including demographic, residential, lifestyle, occupational and environmental characteristics of the child and family.

Direct measurements of lead in air, soil and tap water were carried out. Air lead was monitored in each of the sites by Ministry of the Environment air samplers. The schools closest to the air monitor were chosen as the sample schools and levels of lead in tap water were measured in each school. Soil lead levels were measured in play areas of each schoolyard. In addition to these environmental measures, traffic density and the lead content of gasoline sold in the gasoline stations of each site were also ascertained.

FIGURE 1

STUDY DESIGN AND SAMPLE SIZE



Air, soil and water lead levels as well as traffic measures, were used to construct an environmental profile of each site. This environmental profile, together with other family and personal risk factors, was used to build a statistical model to determine the contribution of all risk factors to the blood lead levels of the children.

For blood lead levels in children, an alert level of 20 micrograms of lead per decilitre of whole blood (20 ug/dl, or 0.97 umol/l) or above was established. This level was chosen to identify children who may have an increased exposure to lead. All children in this survey whose blood lead levels were at or above the alert level by the study's procedures were referred to their local medical officer of health for follow-up. An elevated blood lead level, which reflects excessive lead absorption, is a confirmed blood lead of 25 ug/dl (1.21 umol/l) or greater. The term lead poisoning has been applied to an acute process with clinical symptoms. The term lead toxicity has been associated with blood lead of 25 ug/dl or higher and changes in physiological parameters without clinical symptoms. Lead poisoning and lead toxicity are now used interchangeably.

RESULTS

Air lead was measured for up to five months in each site. The measurement for the month during which the children were tested was used in the analysis. The geometric mean for rural, suburban, and urban air lead concentrations were respectively 0.1, 0.2, and 0.4 ug/m³. All levels in this study were below the Ministry of the Environment's air quality criterion of 2.0 ug/m³ calculated as a geometric mean for a 24 hour period.

Measurements of lead and bromine levels in air in each site allowed the calculation of the proportion of air lead attributable to motor vehicle exhaust⁵. These proportions varied by site, with higher proportions in more heavily urbanized areas: 67% ($\pm 5\%$) in Walpole; 77% ($\pm 5\%$) in Longwoods; 73% ($\pm 5\%$) in Etobicoke; 85% ($\pm 5\%$) in Toronto; and 80% ($\pm 5\%$) in Windsor. Measurements for this calculation were not available for Scarborough.

Soil lead concentrations varied significantly from site to site (Table I). Urban sites, with lead levels ranging from 23 to 180 ppm (sandy soil excluded), means 54 (Toronto) and 72 (Windsor), were higher than suburban, range 6 to 81 ppm, means 20 (Etobicoke) and 22 (Scarborough), and rural sites, range 7 to 170 ppm, means 15 (Longwoods) and 42 (Nanticoke-Walpole).

A single rural sampling location had a mean soil lead level exceeding those of suburban sites. When the measurements for this location were excluded, the mean levels for the rural test areas were 15 (Longwoods) and 16 (Nanticoke-Walpole), with a range from 7 to 51 ppm. The Ontario Ministry of the Environment "upper limits of normal" contaminant guidelines for lead in soil are 500 ppm for urban locations and 150 ppm for rural locations. The reason for the unusually elevated measures in this single rural sampling location remains unclear. The exclusion of values from the single rural location resulted in a soil lead level gradient highest in urban sites, in the mid-range for suburban sites and lowest in the rural sites.

Water lead

No water lead level was above the Ontario maximum allowable concentration (MAC) for lead in drinking water (50 ug/l). The highest mean level among all sites was 12.8 ug/l.

Environmental measures for this study are summarized in Table I.

Distribution of Blood Lead Concentrations in the Children

Blood lead levels varied from site to site among the 1,269 children tested who were ages six years or younger. Urban children had higher geometric mean blood lead levels (12.0 ± 4.4 ug/dl) than suburban children (10.0 ± 3.5 ug/dl), and they, in turn, had higher blood lead levels than rural children (8.9 ± 3.9 ug/dl), a statistically significant difference. However, there was no significant difference between sites in the proportion of children who had lead levels above the alert level of 20 ug/dl; (5.6% of urban, 3.7% of suburban, 3.5% of rural children) (Table 2).

A total of 54 children (4.3% of those tested) were at the alert level of 20 ug/dl or higher, with 18 of these (1.4%) at levels of 25 ug/dl or greater. All children with blood lead levels at or above 20 ug/dl were referred for confirmatory tests and medical follow-up.

Blood lead levels of children in this study were lower than those of a group of Toronto children living in a neighbourhood adjacent to a known lead-emitting source which is monitored regularly.⁴ Comparison of children in this study with these Toronto children tested in the fall of 1984 indicate geometric mean blood lead levels among 4-year olds were 10.2 ug/dl (Ontario study) versus 14.6 ug/dl (Toronto study)*, and among 5-year olds were 10.4 ug/dl (Ontario study) versus 15.1 ug/dl (Toronto study)*. Overall, the blood lead levels of this sample of Ontario children were relatively low (overall geometric mean 10.36 ± 4.2 ug/dl).

Blood lead levels were slightly higher among boys than girls (10.6 ± 4.2 ug/dl versus 9.7 ± 3.9 ug/dl respectively), and among younger children as compared to older children, with geometric mean lead levels for children three years or younger being 11.0 ± 3.9 ug/dl; for 4-year olds 10.2 ± 4.4 ug/dl; for 5-year olds 10.4 ± 4.5 ; and for 6-year olds 9.7 ± 3.5 ug/dl.

*The Toronto results were calculated manually for the Technical Working Group by the statistician for the Toronto study, as it has not yet been published.

Risk Factor Analysis in the Interviewed Group of 800

A random sample of 800 families of children tested for blood lead were interviewed to determine factors related to the children's blood lead levels. Nearly one hundred factors thought to be related to blood lead in children were considered: socio-demographic characteristics, residential housing and neighbourhood characteristics, lifestyle and parental occupational factors. A complete listing of all factors considered in this study is given in Table 3.

Initially, the relationship of each potential risk factor to children's blood lead levels was examined one-by-one without taking into account possible interactions with other risk factors.

The examination of single risk factors was performed to identify those variables which were of significance to apply in subsequent multivariate model building. Because the distribution of risk factors varied between the geographic sites, site was held constant (controlled for) in these analyses. In this pre-liminary assessment, the following factors were found to have a statistically significant relationship to higher blood lead levels (indicated by * in Table 3):

Basic-demographic factors

younger age, male sex, lower socioeconomic status of the family as measured by occupation of the household head;

. Residential/neighbourhood/housing factors

number of gas stations within six blocks of the home, number of 4-lane roads and minor highways within one block of the home, residence within one block of a major highway, the number of industries within six blocks and within one block of the home, apartment residence, presence of a fireplace in the home, presence of radiator heating systems whether oil or gas, lack of an air filter, linoleum flooring in the child's room or play area, presence of peeling paint in the child's room or play area, higher soil lead levels as measured in the schoolyard;

. Lifestyle factors

presence of household pets, tendency of the child to chew or eat non-food items (pica).

Many of the risk factors found significantly related to higher blood lead levels were also strongly related to each other. In order to determine those selected factors which best explain the differences in children's blood lead levels, a series of statistical models was developed in which all factors shown above to be significant were considered simultaneously.

In these multivariate analyses, the following factors were significantly related to higher blood lead levels in children (indicated by X in Table 3):

- . younger age
- . lower family socioeconomic status
- . hot water radiator heating in the home
- . number of gas stations within six blocks of residence
- . number of industries within six blocks of residence
- . residence within one block of a major highway
- . geographic site (Toronto, Windsor, Etobicoke, Scarborough, Longwoods, Nanticoke-Walpole)

These factors taken together were able to account for 20% of the variability in blood lead levels among children.

Environmental measurements of lead in air and soil, together with neighbourhood traffic density, were equivalent to "site" in their ability to predict the variability of blood lead levels among children. When these measurements (air lead, soil lead, traffic density) were substituted for "site" in the model, 19% of the variation of blood lead levels could be explained.

DISCUSSION

When "site" is controlled for, lower socioeconomic status and individual characteristics, such as younger age and male sex, are associated with higher blood lead levels. When all factors in this study were considered together, the major contributor to higher blood lead levels in children was geographic site or its equivalent surrogate measures: air lead, soil lead, traffic density, and the neighbourhood characteristics of number of gasoline stations and industries within six blocks of the child's residence.

These environmental measures and easily ascertainable neighbourhood characteristics are meaningful measures to estimate the potential contribution to the lead burden of children. Four of these five neighbourhood environmental factors are related to the presence of lead in gasoline. Twenty percent of the variance in blood lead levels could be explained by the models developed.

This study did not examine some other known sources of lead to children. Quantitative analyses of dietary intake and its contribution to blood lead were not undertaken. Diet is believed to be a major source of lead for children. Related factors such as non-proprietary medication use, consumption of canned milk and home-grown vegetables, and use of lead-soldered electric kettles were assessed in this study. These factors did not play a significant role in children's blood lead levels.

Environmental measurements of lead - air lead, soil lead, traffic density - were not available or feasible for the individual surroundings of each child. Instead, measurements from selected, centralized locations were used to represent the presence of lead in the child's environment. Longer distances from the measurement locations for some children may have reduced the power of these measures to account for variation in children's blood lead levels.

The blood lead levels in this sample of 1,269 Ontario urban, suburban and rural school children ages six and under, were lower than those reported in similar studies. The blood lead levels of 4 and 5-year olds in this study were significantly lower than those of the 4 and 5-year old children tested the same year and season in a neighbourhood of Toronto (Riverdale) which is adjacent to a known source of lead emissions.

The timing of blood lead testing in early fall following maximal outdoor exposure during summer months would be expected to result in peak blood lead levels in children. The majority of children with blood lead levels at or above the alert level (≥ 20 ug/dl) on initial screening had lower levels upon follow-up testing.

This study required that lead be determined on capillary blood samples. Although this technique may have a greater possibility of contamination and false positive results, the less invasive nature of the technique makes it more acceptable than venous blood sampling for large scale studies of young children. If the amount of blood collected is sufficient for the analytic method, false negative results for this method are minimal. The possibility exists of false positive results and stress associated with incorrectly identifying children as having elevated blood lead levels. However, this is balanced by the assurance that those with true elevated levels will be detected rather than going unnoticed, and confirmatory tests are used to follow-up those identified as positive by screening procedures.

The decrease in blood lead level for most of the children with determinations above the alert level may reflect either an initial false positive result or a true decrease in blood lead level due to reduced seasonal exposure to sources of lead.

This study did not specifically examine northern Ontario children. The concerns about lead exposures of children in some northern Ontario communities may be quite different and would be reflected in variables not examined in this study. There are communities where lead pipes are used extensively in homes and conditions of water supplies are conducive to the leaching of lead into the water. Specifically designed studies of children in these areas may be warranted.

CONCLUSIONS AND RECOMMENDATIONS

Lead from leaded gasoline accounted for a high percentage of lead in air in urban, suburban and rural environments (67% to 85%).

Air lead measurements did not exceed Ontario guidelines.

Soil lead measurements were relatively low (4-180 ppm) in urban, suburban and rural sites chosen.

Water lead at the tap of schools attended by the children was low and met Ontario drinking water guidelines. Water did not appear to contribute significantly to children's blood lead levels.

Overall mean blood lead for children ages six and under was low (10.36 ± 4.2 ug/dl) when compared to children in point source areas.

Urban children had higher levels of blood lead than suburban children, and suburban children had higher blood lead levels than rural children.

Preschoolers (aged 4 and 5) showed higher mean blood lead concentrations than 6-year old children. It would be judicious to target preschoolers for case-finding and intervention, especially in urban areas near heavy traffic. Screening of this target population is a sensible, preventive public health measure.

Lead additives in gasoline were demonstrated to be the major contributor to lead in air in this study of children living in non-point source areas. Reduction of lead in gasoline will likely result in some decrease in children's blood lead levels. The clinical significance of this potential reduction needs further consideration.

A determination of the dietary contribution of lead to children's lead body burden is worthy of further assessment. Regular Canadian food basket analyses are important in the continuing assesement of sources of lead body burden in children.

TABLE 1

SUMMARY OF ENVIRONMENTAL MEASURES IN URBAN, SUBURBAN AND RURAL SITES

Environmental Measure	Urban		Suburban		Rural	
	Windsor	Toronto	Scarborough	Etobicoke	Nanticoke-Walpole	Longw
Air Lead, ug/m ³ , geometric mean (a)	0.2	0.7	0.2	0.2	0.1	0.1
Annual Average Daily Traffic (b)	8,758	14,430	13,700	14,600	4,133	3,708
% Air Lead attributable to Vehicle Exhaust	80%	85%	N/A	73%	67%	77%
Average Lead Content of Regular Leaded Gasoline Sold at Local Gas Stations, g/l (c)	0.527	0.460	0.482	0.454	N/A	0.510
Soil Lead, ppm, mean (d)	All Soil	54	48	20	25(11)(e)	13
	Sandy Soil Excluded	72	54	22	42(16)	15
Water Lead, ug/l, mean (f)	First draw of day	2.5	11.4	12.8	8.0	7.1
	Second draw; tap running 5 minutes	1.8	2.9	1.2	5.0	1.2

- (a) Ministry of Environment air quality criterion for lead in air is 2.0 ug/m³ geometric mean for a 24 hour period.
- (b) Sources: Ministry of Transportation and Communications. Data from traffic volume sampling for specific sites, 1983. Average 24 hour two-way traffic for the calendar year. Traffic Engineering Department, City of Windsor. Department of Roads and Traffic, Municipality of Metropolitan Toronto.
- (c) Source: Environment Canada, Environment Protection Service. Data from retail outlet sampling program, 1984.
- (d) Ministry of Environment "upper limits of normal" contaminant guidelines for lead in soil are 500 ppm for urban and 150 ppm for rural locations.
- (e) With the exclusion of the single site with unusually high levels, average soil lead levels for measurement sites in the vicinity of Nanticoke-Walpole were 11 ppm (all soil) and 16 ppm (sandy soil excluded). Reason(s) for elevated levels in the single measurement site could not be determined.
- (f) Ontario Maximum Acceptable Concentration for lead in drinking water is 50 ug/L.

TABLE 2

GEOMETRIC MEAN LEVELS AND DISTRIBUTION OF BLOOD LEAD CONCENTRATIONS BY
RESIDENCE AMONG SAMPLED ONTARIO CHILDREN AGED SIX AND UNDER

RESIDENCE		BLOOD LEAD CONCENTRATION								Total # Children Tested
	GEOMETRIC MEAN(±SD) (ug/dl)	umol/L	0-.23	.24-.47	.48-.71	.72-.96	.97-1.20	1.21-1.44	≥1.45	
		ug/dl	0-4	5-9	10-14	15-19	20-24	25-29	≥30	
URBAN										
# (%)	12.02(±4.4)	2 (0.5)	112 (28.6)	180 (45.9)	76 (19.4)	15 (3.8)	5 (1.3)	2 (0.5)	392	
SUBURBAN										
# (%)	9.95(±3.5)	13 (2.6)	250 (49.3)	194 (38.3)	31 (6.1)	11 (2.2)	5 (1.0)	3 (0.6)	507	
RURAL										
# (%)	8.91(±3.9)	27 (7.3)	207 (55.9)	98 (26.5)	25 (6.8)	10 (2.7)	0 (0.0)	3 (0.8)	370	
TOTAL										
# (%)	10.36(±4.2)	42 (3.3)	569 (44.8)	472 (37.2)	132 (10.4)	36 (2.8)	10 (0.8)	8 (0.6)	1269	

TABLE 3

Risk Factors Considered in the Interviewed
Sample of 800 Families and their
Relationship to Children's Blood Lead Levels

Socio-demographic Factors

- x * Age of child
- * Sex of child
- Number of adults living at home
- Number of children living at home
- Use of a family doctor
- x * Father's current occupation
- Father's previous occupation
- Father's part-time occupation
- x * Mother's current occupation
- Whether mother is or has been a leadworker
- Mother's previous occupation
- Mother's part-time occupation
- Current occupation of other adults living with child
- Whether other adults are or have been leadworkers
- Part time occupation of other adults

Residential/Housing Factors

(For each of up to three residences lived in for longest periods of time during a child's lifetime)

Age of house
Length of residence (in years)
Type of construction (brick, wood, stone, aluminium, stucco, insulbrick, other)
Painted exterior
When exterior last painted

- *= Significantly associated with blood lead level ($p < .10$) in univariate analyses
- x= Significantly associated with blood lead level ($p < .05$) in multivariate analyses (all * factors considered simultaneously).

- Residence built on landfill
- Top soil added to yard
- Unsodded bare patches of soil in yard
- Presence of vegetable garden
- Child's usual outdoor play area (own yard, friend's yard, street, park, other)
- Percentage of bare ground in child's favourite play area
- x * Type of heating (oil-forced air, oil-hot water, gas-forced air, gas-hot water, hydro, wood stove, hot water-radiator)
- * Presence of fireplace
- Frequency of fireplace use
- Burning of newspapers with coloured inks in fireplace
- Presence of forced air heating
- * Presence of air filter
- Presence of air cleaner
- Presence of air conditioner
- Major renovations during child's lifetime
- Source of water supply
- * House or apartment

The following were determined by physical inspection:

- Type of pipes in kitchen (galvanized iron, copper, lead, plastic, combination with lead, combination without lead)
- Type of pipes in bathroom (galvanized iron, copper, lead, plastic, combination with lead, combination without lead)
- Type of pipes in basement (galvanized iron, copper, lead, plastic, combination with lead, combination without lead)
- * Type of flooring in child's room (broadloom, bare hardwood, area rugs, linoleum, other)
- * Condition of paint in child's room (peeling, some peeling, no peeling)
- * Type of flooring in child's favourite play area
- Condition of paint in child's favourite play area
- Condition of exterior paint

- *= Significantly associated with blood lead level ($p < .10$) in univariate analyses
- x= Significantly associated with blood lead level ($p < .05$) in multivariate analyses (all * factors considered simultaneously).

Neighbourhood Factors

- x Number of gas stations within 6 blocks of residence
- Number of 4 lane roads within 6 blocks
- Number of minor highways within 6 blocks
- Number of major highways within 6 blocks
- x * Number of major industries within 6 blocks
- Number of gas stations within 1 block
- * Number of 4 lane roads within 1 block
- * Number of minor highways within 1 block
- x * Number of major highways within 1 block
- * Number of major industries within 1 block
- Kind of road in front of house

Lifestyle Factors

- Family hobbies (soldering, painting, stained glass making, pottery glazing, auto repair, furniture refinishing)
- Use of own home grown vegetables
- Frequency of use of own home- grown vegetables
- Use of canned milk
- Frequency of use of canned milk
- Use of electric kettle
- Age of electric kettle
- Use of medication by child
- * Presence of pets
- * Tendency to eat or chew non-food items (pica)

- *= Significantly associated with blood lead level ($p < .10$) in univariate analyses
- x= Significantly associated with blood lead level ($p < .05$) in multivariate analyses (all * factors considered simultaneously).

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Editing of the final document was undertaken by the Technical Working Group.

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Abstract

Blood Lead and Associated Risk Factors
in Ontario children: 1984

Lead exposure from the external environment as well as the home has received much attention in the past decade. In the absence of information on the blood lead levels of Ontario children who are not exposed to a known source of industrial emissions, the Ministries of Labour, Environment and Health undertook the Ontario Blood Lead Study. The purpose of this study was to determine blood lead levels in Ontario children and to identify those demographic, environmental and lifestyle characteristics related to higher blood lead levels.

1315 children aged 7 and younger in selected urban (Toronto-Windsor), suburban (Etobicoke, Scarborough) and rural (Longwoods, Nanticoke-Walpole) areas of Ontario were sampled for analysis of blood lead. Blood lead concentration was determined in finger prick blood samples by graphite furnace atomic absorption spectrophotometry. Measurement of lead in air where children live, lead in tap water at their school, and lead in soil in areas where they play was carried out. Traffic density was measured at the largest intersection nearest to the children's school. A random sub-sample of 800 families of 1269 children aged six and under tested for blood lead was assessed for the presence of risk factors which may be associated with elevated blood lead concentrations.

Urban children had higher geometric mean blood lead levels (12.0 ± 4.4 ug/dl) than suburban children (10.0 ± 3.5 ug/dl), and they in turn had higher blood lead levels than rural children (8.9 ± 3.9 ug/dl), a statistically significant difference. Among all children, 4.3% were at or above the alert level of 20 ug/dl; the proportion above the alert level did not differ between urban, suburban and rural areas. Blood lead levels were slightly higher for males than females and for pre-schoolers aged 3 and 4, compared to school age children aged 5 and 6. The distribution of blood lead levels among these children was lower than that of children in point source areas.

Multivariate statistical modelling resulted in a set of characteristics which best explained the differences in children's blood lead levels: younger age, lower family socioeconomic status, hot water radiator heating in the home, number of gas stations within six blocks of residence, number of industries within six blocks of residence, residence within one block of a major highway, and geographic site (Toronto, Windsor, Etobicoke, Scarborough, Longwoods, Nanticoke-Walpole). Environmental measurements of lead in air and soil, together with neighbourhood traffic density, were equivalent to "geographic site" in their ability to predict variations of blood lead levels among children. These environmental measurements and neighbourhood characteristics were meaningful surrogates for "site" in being able to estimate their potential contribution to the blood lead level of children.

Five of the seven factors most closely related to children's blood lead levels are measures of lead in the physical environment. The prime contributor to air lead in the areas tested was lead in gasoline. Reduction of lead in leaded gasoline may be expected to produce some reduction of blood lead levels in children in Ontario.

CHAPTER 1.0 INTRODUCTION

1.1 Background

In August 1984, an Interministerial Technical Working Group, representing the Ontario Ministries of Health, Labour, and Environment, awarded A.R.A. Consultants a contract to conduct a study of blood lead concentrations and associated risk factors among a sample of Ontario children. The study was designed to collect blood from a large sample of young Ontario children, and to relate the resulting findings of lead concentration to information gathered from family interviews and to direct measures of environmental lead levels in the air, water and soil.

The present study was designed to determine the concentration of lead in blood of Ontario children. Up to now, the concentration of lead in blood of Ontario children not exposed to known or suspected sources of lead has not been studied. A number of studies have been conducted in Ontario to test blood lead levels of children living near specific point sources of lead such as lead processing plants.^{12,26} These studies are difficult to evaluate in the absence of data establishing expected ranges of blood lead levels in populations not living near a point source of lead, e.g. industries, refineries or smelters which have high lead content emissions.

1.2 Literature Review

The detrimental effects upon health of exposure to inorganic lead compounds is well established. The most significant detrimental effects are believed to be upon the hemopoietic, nervous and urinary systems (blood, brain and kidney). The population groups at greatest risk to chronic low-level lead

exposure are children under 6 and the fetus in utero, and therefore indirectly, the pregnant woman.

Elevated blood lead concentrations in the 1970's were considered to be levels greater than 0.40 mg/L (40 ug/dl).¹² In April 1978 the United States Centers for Disease Control (CDC) published "Preventing Lead Poisoning in Children".²⁴ This publication received widespread acceptance and established guidelines for the classification of children according to their blood lead level. These guidelines suggested that a confirmed whole blood lead level of 30 micrograms per decilitre (30 ug/dl; 0.30 mg/L) or greater was elevated and indicative of excessive absorption. In 1985 a new document²⁷ was published by CDC in which they recommended a guideline for children; a confirmed level of twenty-five micrograms of lead per decilitre of whole blood or greater (0.25 mg/L; 25 ug/dl). At this level or greater, the child is considered to have an elevated blood lead reflecting excessive absorption of lead. Lead toxicity is a confirmed whole blood lead level of 25 ug/dl with a whole blood erythrocyte protoporphyrin (EP) level of 35 ug/dl or greater. The CDC document suggests that the term lead poisoning and lead toxicity are synonymous and may be used interchangeably. Lead toxicity is frequently used to describe a child who has the hematological changes described above but who has no clinical findings. This distinction is arbitrary, however. Lead poisoning (or toxicity) is not common in Canadian children, although up to six percent of children tested who live near point sources of lead emissions have been shown to be above these guidelines.²⁶

The clinical symptoms of lead poisoning in children vary from general malaise, failure to thrive and abdominal pain to significant permanent, irreversible brain and kidney damage.

In the last decade, research has attempted to document the effects of lead on behaviour, learning and intelligence. Learning deficits at low levels of exposure to lead have not been established unequivocally.^{9,10,11} The effect of lead on the nervous system and its potential effects on intelligence, learning and behaviour are a cause of public health concern.²

Environmental Sources of Lead

There are a number of avenues of exposure to lead in the environment. Lead-based paint has been cited as the most common source of lead exposure for children in the United States.^{1,3} It has not been established that this is the case in Canada.

Although current Canadian regulations do not permit the manufacture of lead-based paint for interior use, it still is available for exterior use (with a warning label). Older houses with layers of pre-World War II paint may pose a hazard to young children, particularly during renovation when paint is removed from walls. Lead paint is attractive to children because of its sweet taste. Some paints manufactured in the 1940s contained up to 50% lead by dry weight.¹²

Only a small percentage of children could be clinically defined as having pica, the tendency to eat non-food items such as dirt or plaster. Many small children mouth various objects in the environment and often put their hands in their mouths. This behaviour could result in increased ingestion of lead-contaminated dust.

Parents whose occupation involves exposure to lead may bring lead containing dust into the home on shoes or clothing.

The emissions from some industries have a high lead content and may be an environmental source of lead exposure for children living nearby.

Food is a significant contributor to the body burden of lead. Studies of dietary sources of lead in North America indicate that average consumption ranges between 100 and 220 micrograms of lead per day for adults.¹³ Studies carried out by the Canadian Department of National Health and Welfare have determined that adults without occupational exposure to lead have an estimated total daily intake of 132.4 ug of which 70% is from food, 20% from air, 4% from water and 6% from soil, dirt and dust. For children one to three years of age, 66% is from food, 32% from soil, dirt and dust, 2% from air, and less than 1% from drinking water.³¹

The amount of lead consumed by children would vary as a function of the size of the child and the total calories consumed. It is estimated that a two-year-old child might ingest 50 to 110 micrograms of lead per day through the diet. A critical review of health effects of lead ingestion in infants and young children¹³ resulted in the recommendation that the lead intake for children between six months and two years of age be no more than 150 ug/day. Using these figures, a typical two-year-old may consume between one-third and two-thirds of the maximum allowable daily lead intake through dietary sources.

In some areas, particularly those with soft, acidic water supplies, lead may be leached from lead pipes or connectors, or from joints soldered with lead-tin solder.⁷ The current Ontario Maximum Acceptable Concentration (MAC) of lead in water is 50 ug/L. A two-year-old child consuming one liter of water per day at the Ontario MAC would ingest one third of the maximum allowable daily intake by this route.

Lifestyle factors may affect children's exposure to lead. Hobbies such as packing shotgun shells at home, drinking from hand-crafted ceramics using

lead glazes, or working with lead-tin solder while making stained-glass windows may result in children's exposure to lead. The use of folk remedies which include lead as an ingredient has been established as cause of lead poisoning in children.¹⁵ If painted wood or newspapers using lead-based coloured inks are burned as fuel in open fireplaces, children may be exposed.

Air-borne lead is regarded as a low dose source of environmental lead exposure. Even though it may not represent the immediate threat to health that is presented by the ingestion of lead paint and exposure to lead - contaminated point-source emissions, airborne lead has exposure implications for a much larger number of children than those potentially at risk from a specific point source.

Lead in the air comes from two major sources: industry and exhaust of automobiles fuelled by leaded gasoline. Data from on-going research in Canada and other countries have established that both air and soil in areas in proximity to point sources have higher lead levels. This has been associated with increased blood lead concentrations in children who live and play in these areas.¹⁶

Automobile exhaust has been identified as a significant source of lead in ambient air.²⁸ Lead in gasoline, used as an anti-knock agent, has become a serious area of concern over the last 15 years in the United States and Canada. Among countries regulating lead in gasoline levels, Canada permits the fourth-highest level in the world, exceeded only by South Africa, Australia and New Zealand.²⁹ Installation of federally-mandated emission-control devices on new automobiles in the U.S. has been linked to a reduction in average blood lead levels. The U.S. Public Health Service NHANES cross-sectional study of blood lead levels in persons aged 6 months to 74 years over the period 1976 to 1980 reported a 37% decrease in blood

lead levels.⁵ In March 1985, the U.S. Environmental Protection Agency informed gasoline refiners that they must eliminate 90% of lead in gasoline by January of 1986 and announced that a total ban on leaded fuel was being proposed for 1988. In Canada, the permissible level of lead in leaded gasoline was amended in May, 1984 from the present level of 0.77 g/L to 0.29 g/L by 1987.³² Among the major gasoline supplies in Canada, average leaded gasoline lead concentrations at present are generally under 0.44 gm/L (Table 6).

Children living in urban centres are thought to be at greater risk for lead exposure than children in suburban or rural areas. This may be due to increased traffic density and industrialization in these centres. The relative contribution of each source of lead in the environment is not fully understood.

There have been no previous studies which provided data on blood lead concentrations among randomly selected Ontario children. The present study was designed to collect information on blood lead levels and risk factors affecting blood lead for a sample of Ontario children. The study also attempts to understand the relationships of these factors for children who are not at risk from a known point source of lead exposure.

1.3 Objectives of the Study

Objectives of the study were:

- o to determine the distribution of blood lead concentrations in a selected sample of Ontario children in areas free of known sources of industrial lead emissions;
- o to determine if variations in blood lead levels in children conform to any urban-suburban-rural pattern;

- o to determine among these children the presence of specific risk factors shown in previous studies to be associated with elevated blood lead concentrations;
- o to identify those factors that might be associated with variations of blood lead concentrations in Ontario children.

The target population for this study was defined as Ontario children under seven years of age, of both sexes, attending school in urban, suburban, and rural sites with no known point source of lead in the vicinity and having a Ministry of the Environment air sampler in place. Because children are more likely to play outdoors during the summer months, they may be more likely to be exposed to environmental sources of lead during this time. Collection of blood samples for lead determination was scheduled for the six week period immediately following the opening of school, from late September through mid-November 1984.

The relationship between blood lead and the following factors was tested statistically:

- o place of residence (urban, suburban and rural);
- o levels of air-borne lead, soil lead, water lead;
- o residential proximity to gas stations;
- o proximity to roads; and
- o residential, occupational and lifestyle factors.

The variables tested are detailed in Table 21 which corresponds to Table 3 in the Technical Working Group Summary document entitled Blood Lead and Associated Risk Factors in Ontario Children, 1984: Summary and Conclusions.

The measurement of these variables is discussed more extensively in Chapter 4.

CHAPTER 2.0 SAMPLING PLAN AND IMPLEMENTATION ACTIVITIES

This section describes the sampling plan for the study, the activities which were necessary to gain community and local administrative acceptance of the study, and the specific procedures and measures which were employed for collection of data.

2.1 Sampling Plan

The study was designed to sample and interview a minimum of 800 children of both sexes from urban, suburban and rural sites in the age groups of under four years, five years and six years of age. The Ontario Ministry of the Environment selected six sites which it considered to be representative of urban, suburban and rural levels of air-borne lead from the approximately 120 air-quality sampling sites that it maintains throughout the province. Two urban sites (Toronto and Windsor), two suburban sites (Etobicoke and Scarborough) and two rural sites (the Longwoods area near London and the Walpole area near Nanticoke) were selected. Historical data were available for each site, and no site was adjacent to a known point source (e.g., a lead smelter). Elementary schools closest to the air sampler were selected for the study. The concentration of lead in air as measured by the air sampler in the vicinity of the selected school was taken to be the most representative component of a child's background exposure to lead in air. (For maps showing each site and the location of the air samplers, see Appendix B.)

Based on enrollment figures for kindergarten and grade one, from four to six schools were selected in each of the six sites to allow the selection of a sufficient number of children per site.

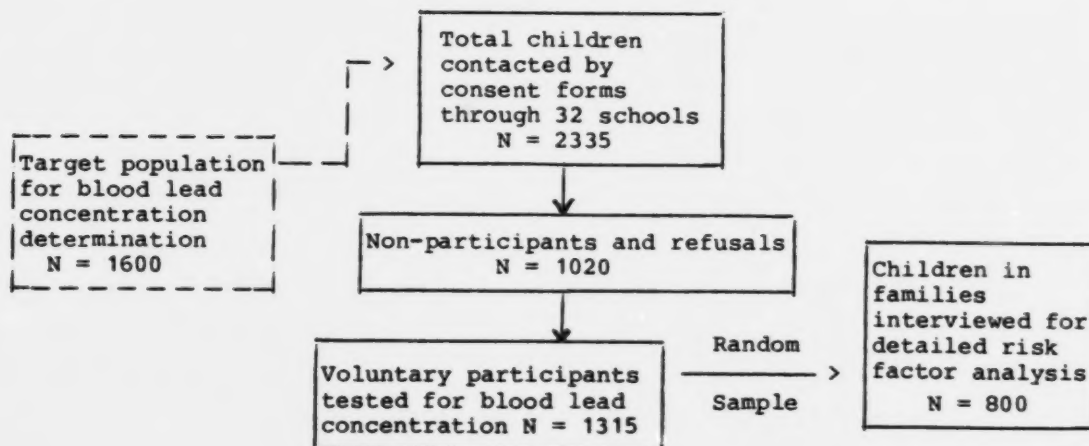
One school near an air sampler was eliminated from the study because the children attending were not drawn from the neighbourhoods close to the school. In the more heavily populated sites, all of the schools were within 1.5 kilometers of the sampler. Schools in the rural sites, however, were

considerably farther from the sampler. Although all the schools in the Longwoods site were located within approximately 8 kilometers of the air sampler, schools in Walpole site were much more dispersed. Four of the six schools were located within 8-10 kilometers of the sampler which was located in Walpole, while two of the schools were located in Dunnville, approximately 40 kilometers away. A complete list of the schools chosen for this study is presented in Appendix C.

The target sample size for blood testing was set at 1,600 children. All children in junior kindergarten, kindergarten, and grade one classes in the schools at each site, up to a maximum of 270 children per site were eligible for measurement of blood lead. The target sample size of 1600 for blood testing was selected so as to provide 800 interviews, anticipating a 50% consent rate for interview.

A total of 1315 children were tested for blood lead. From this initial group, a total of 800 children were selected randomly for more detailed risk factor analysis. The sample size of 800 was selected to ensure an 80% chance of detecting a 14% difference in blood lead level between groups of children classified by age, sex, and degree of urbanization. For a schematic diagram of the sampling plan, see Figure 1 below.

FIGURE 1
STUDY DESIGN AND SAMPLE SIZE



2.2 Initial Implementation Activities

In order to gain cooperation and participation, contacts with key organizations proceeded as follows:

- o a letter of introduction describing the study was sent from the Chief Medical Officer of Health to the Medical Officer of Health in each site;
- o letters were sent from the Ministry of Education to Regional Directors of Education;
- o personal contacts were made by A.R.A. Consultants to Regional Directors of Education and Boards of Education;
- o following approval by school boards, contacts were made by A.R.A. Consultants with principals in selected schools; and
- o letters and consent forms were developed for parents by A.R.A. Consultants modelled after those used by the Toronto Department of Public Health.

(Copies of letters are in Appendix D.)

Concurrent with efforts to implement the testing program in the schools, other arrangements to conduct the study were made. Four registered nurses were trained to collect blood samples from the children. All of the nurses had extensive previous experience in pediatric nursing. All of the nurses participated in a training session where they experimented with the finger-prick blood sampling method and reviewed procedures and problems which might occur.

2.3 Finger-Prick Blood Testing Method

The method of obtaining samples of blood for this study was the finger-prick method for sampling capillary blood described in the consent form as "a small prick in the child's finger to draw out a few drops of blood".

Although capillary and venous blood lead levels should, in theory, be identical, the research literature suggests that capillary blood samples tend to give higher readings of blood lead. The reasons for these higher levels are usually attributed to the problem of contamination of the sample. Because the capillary sample is so much smaller than the venous sample, contamination consequently may be more significant in this method of sampling.

Although the source of the contamination is usually thought to be lead on the surface of the skin, it can also be due to lead contamination of the sampling tubes or containers. On the other hand, lower lead values of capillary versus venous blood may reflect dilution of the sample by extracellular fluid resulting from excessive compression of the puncture site. An awareness of the potential for contamination of a finger-prick sample has been discussed in the literature. The usual recommendation is to obtain venous blood. With good technique, the correlation of finger-prick and venous samples has been shown to be above 90%.¹⁸

2.4 Purchase and Testing of Supplies

All of the supplies necessary for the conduct of the entire study were purchased before the blood testing began, since if there had been problems in obtaining supplies on an intermittent basis, these difficulties might have compromised the blood collection activities. Previous studies had used capillary tubes to collect the fingertip blood samples along with microtainers into which the capillary tubes were then expelled. The Ministry of Health Laboratories suggested the use of a plastic heparinized microtainer to which a collector-top could be attached. This microtainer was found to be as easily usable by the nurses as were capillary tubes. Since they were plastic, they were also substantially less likely to break. After experimenting with both methods, the plastic microtainers were preferred.

The micro-lancets used were 2 cm long, with plastic handles and an attached micro-lancet. The micro-lancets were used manually as the nurses felt this method was as efficient as using the puncturing apparatus supplied and was less frightening to the children.

Sugarless lollipops and stickers of teddybears and unicorns were provided to give as tokens to the children after they had had their blood tested. For such young children, these tokens were seen as important in making the procedure more pleasant.

The team experimented with various methods of labelling the samples to ensure accurate identification of each sample. The final decision was to affix labels containing the child's name and serial number corresponding to that on the nominal roll directly to the microtainer immediately after the child was tested. A complete description of all of the supplies necessary for the study is in Appendix E.

2.5 Ensuring Lead-Free Supplies

Since contamination was an issue of serious concern for the study, it was essential that all of the supplies be carefully selected so as to be free of lead. For all supplies with a potential for contaminating the blood samples, individual manufacturers were contacted and inquiries were made about the lead content of supplies. For example, the manufacturer indicated that the soap purchased for this study was lead-free. Similarly, we selected paper towels which did not contain any recycled materials, which may have contained lead.

To ensure that the heparinized microtainers in which the blood was to be collected were lead-free, a random sample of microtainers from the supplies ordered for the study was selected and sent to the Ministry of Health Laboratory for analysis. Each microtainer was first washed with hydrochloric acid and then filled with a saline solution and shaken for 24 hours before analysis for lead. The saline solution used mimics the action of human blood in a container of this type. Eighty microtainers were tested. The detection limit of the test is 0.15 ug/dl or 0.007 umol/L. No detectable levels of lead were found in any of the microtainers tested.

CHAPTER 3.0 COLLECTING BLOOD SAMPLES

This chapter describes the procedures for the collection of blood samples from children, techniques used in analyzing the blood samples and the follow-up and reporting of results.

3.1 Arrangements With Schools

As part of the implementation process, Directors of Education had agreed to contact school principals by letter, informing them of the rationale for the study and requesting their participation. Once principals were likely to have received these letters, they were contacted by telephone for permission for the testing to take place in their schools.

There were variations among the locations in the length of the approval process to begin in schools, from approval in the Walpole and Longwoods areas by the second week in September and approval for testing in the Toronto schools the third week in October. (See Table 1 for a calendar of testing dates for each school.)

School principals were contacted and the study discussed with them, giving them the opportunity to ask questions. Their cooperation was requested in providing a room with hot and cold running water in which to conduct testing, and in ensuring that teachers oversee the distribution of consent forms and letters of explanation for children to take home to their parents. Many principals provided students from grades seven or eight to assist in escorting the children to the testing room on the testing day. Most principals provided class lists to facilitate the management of consent forms and refusals.

Consent forms and letters to parents were delivered by courier to the school approximately one week before the testing. The forms were usually sent home with the children two or three days before the testing date. If at all

possible, the field researcher visited the school the day before the testing to pick up completed consent forms and organize the nominal rolls for testing.

In the Windsor school system, the Director of Education and the Medical Officer of Health co-signed their own version of a letter of explanation to parents. In all other school districts, the letter of explanation was sent under the letterhead of A.R.A. Consultants.

3.2 Consent Rates

For the overall sample, the consent rate was 50%. Consent rates were higher in the rural sites: 62% of the parents in the Walpole schools consented to the procedures, as did 55% of the parents at the Longwoods site. The lowest consent rate was in the Toronto schools; 33% of parents in the Toronto schools gave their consent (Table 2).

Twelve percent of parents sent back consent forms indicating that they refused to have their child participate. Given the age of the children, it is possible that a portion of the consent forms never made it home for the parents to sign or did not survive the trip back to school. A small proportion of children with signed consents was not tested (1.3%). Some were absent from school on the testing date and some children refused to be tested. Occasionally, a consent form contained instructions from the parent that a child could be tested only if he or she did not seem upset at the prospect. Children were never forced to participate when they were distressed. On one occasion in a single class, this position resulted a substantial reduction in the number of children tested.

3.3 Blood Testing Procedure

Upon arrival at the school, the nurses collected any additional signed consent forms and refusals, and proceeded to set up the testing room, usually a classroom or the nurse's office. The project field supervisor sent the student helpers to escort children to be tested from their classrooms to the testing room. When the children arrived in the testing room, a label was prepared for the blood microtainer which was attached to their consent form. The children were then told that the nurse was going to prick the end of their finger and take a few drops of their blood, and that the procedure would hurt a little, but not a lot. They were then told that they would be able to choose any sticker of their choice from a wide variety available, and that they would be able to choose whatever colour of sugarless lollipop they wanted. For most children, these inducements seemed to be very attractive and appeared to allay some of their fears.

The nurses or the student escorts then supervised the vigorous washing of the children's hands with soap, a nailbrush and warm water, and then dried the hands with paper towels. The children were told to "steeple" their hands together in front of their chins to prevent contamination on other surfaces. The nurse would then swab the finger to be tested with an alcohol swab, use a cotton gauze to wipe the finger dry and make a swift pinprick incision using a sharp disposable lancet. The drop of blood which welled up was allowed to run into the collector-top of a microtainer until approximately 100 uL was collected. The nurses were instructed not to squeeze the finger any more than necessary, but rather to ensure that the initial fingerprick was deep enough to allow the blood to well up from the incision. Two 100 uL samples were collected from each child. After the blood was collected and a small elastic bandage placed on the finger, a gummed label on which was written the child's name and serial number was placed on the microtainer. The child was allowed to choose a sticker and lollipop, and was escorted back to the classroom.

3.4 Storage and Transport of Blood

After the blood samples were collected, the microtainers were placed in a cardboard box which was, in turn, placed in a styrofoam cooler equipped with small frozen icebags. For the Toronto and Walpole site testing, all blood was transported by the end of the day to the Ministry of Health Laboratory for analysis. In Windsor and London, blood was stored in the hotel refrigerator overnight and transported on the following afternoon to the Ministry of Health Laboratory for analysis.

Previous studies had encountered difficulties in using fragile glass capillary tubes and glass storage sample tubes. The use of the small plastic microtainers in this study enabled simple transport and storage of the blood and minimized risk of breakage. For a study of this size and complexity, the plastic microtainers proved very practical.

3.5 Laboratory Analysis

The Ministry of Health Laboratory analyzed blood samples for lead by atomic absorption spectrophotometry. Two 100 uL samples of blood were obtained from each child. Two separate analyses were carried out and the average value was reported as the child's blood lead level. The difference between the two analyses of all samples was not statistically significantly different (Appendix F, Table 1). A detailed description of the laboratory analysis techniques is provided in Appendix F.

Close contact was maintained with laboratory staff in order to ensure that potential difficulties in collection and transport procedures could be detected early. Indeed, during the first week of the study, the staff informed us that some samples were too small for proper analysis, so nurses were instructed to make sure that they obtained at least 100 uL of blood

from each child. Results of the blood lead analysis were usually available within one week.

3.6 Follow-Up of Children With Elevated Blood Lead Levels

Ministry of Health Laboratory staff telephoned the results of children found to have blood lead levels higher than 1.45 $\mu\text{mol/L}$ (30 $\mu\text{g/dl}$), the level used in the study to indicate a recommendation for immediate follow-up. The level of 1.45 $\mu\text{mol/L}$ (30 $\mu\text{g/dl}$) was used as recommended by the U.S. Centers for Disease Control prior to February, 1985. During the study, this level was lowered to 1.21 $\mu\text{mol/L}$ (25 $\mu\text{g/dl}$).²⁴ This information was subsequently forwarded by telephone to the Medical Officer of Health in the region where the child lived. In practice, however, all Medical Officers of Health followed up children above the "alert level" of 20 $\mu\text{g/dl}$ (.97 $\mu\text{mol/L}$).

For each of the children with an elevated blood lead level (1.21 $\mu\text{mol/L}$ or higher) a risk factor assessment interview was conducted. The Medical Officers of Health agreed that it would be helpful to have the results of the parent interview in order to provide some information about possible sources of lead contamination. In these cases, an interviewer was sent out immediately, usually on the same day, to collect questionnaire data from the family. In order to provide some measure of protection against bias due to knowledge of the blood lead test results, the interviewers were given three families to interview and were told that the interviews were being done as pretests. They were not informed that one of the children among the families they were interviewing had had a blood lead level higher than 1.45 $\mu\text{mol/L}$. In addition to this follow-up procedure, information on every child with blood lead levels higher than .97 $\mu\text{mol/L}$ (20 $\mu\text{g/dl}$) was forwarded to the Medical Officers of Health for each area.

After the families of the children had been interviewed, copies of the questionnaire were sent by courier to the Medical Officers of Health. The follow-up medical investigations were usually done in cooperation with the

family doctor, and all children identified as having blood lead levels higher than 1.21 umol/L were offered repeat testing for blood lead levels. [Table 3 presents data on the number of children with blood lead above the "alert" level of .97 umol/L (20 ug/dl)]

For children whose results were not above 1.21 umol/L, the general interviewing process did not start for any site until after all of the blood samples were taken. This enabled random sampling from the entire population of tested children at each site, and maintenance of interviewer "blindness" with respect to the results of the blood test.

3.7 Reporting Results to Parents

After testing was completed at all sites and results received from the laboratory, letters were sent to the parents of every child that had participated in the study. The letters reported the actual numerical value of the laboratory test for lead for the child, and also explained the meaning of the laboratory result in the context of urban, suburban, and rural settings. Of the 1,315 letters which were sent, approximately forty-five were returned for various reasons, including inaccurate addresses or because the family had moved. In these cases, efforts were made to track down the proper address of the family, usually by contacting the school. In some cases, letters were sent to schools for parents to pick up. In four cases, families had left the province, and had left no forwarding address. A copy of the letter reporting results to parents is included as Appendix G.

In addition to the reporting of results to parents, letters were also sent to the principals of each school, reporting general results of the study for the area and thanking them for their participation. More extensive reports

were sent to Medical Officers of Health for each of the areas involved. Medical Officers of Health were sent the names and addresses of all children in their area with laboratory results reported as higher than 0.97 $\mu\text{mol/L}$ (20 $\mu\text{g/dl}$) for follow-up and investigation.

3.8 Follow-up by Medical Officers of Health

For each area, Medical Officers of Health arranged for re-testing of blood lead levels of all children found to have blood lead concentrations higher than 1.21 $\mu\text{mol/L}$ (25 $\mu\text{g/dl}$). In most areas, all children with blood lead levels higher than .97 $\mu\text{mol/L}$ (20 $\mu\text{g/dl}$) were also given follow-up testing. In some cases follow-up test results indicated that the child was still at risk and in one family, a brother had an elevated blood lead level as well. In most cases, follow up tests revealed a decrease in blood lead level. This pattern of decline in blood lead levels could have several explanations. First, the original blood sample may have been contaminated by ineffective hand-washing at the time of testing. Second, the capillary blood testing method may have biased the results upward, while the venous test follow-up procedure recommended by the Medical Officer of Health may have resulted in lower values. Finally, since maximum exposure to lead falls near the end of summer, the period of time that passed before re-testing may have resulted in a drop in blood lead levels.

TABLE 1

SCHEDULE OF BLOOD LEAD TESTING IN SCHOOLS

<u>Date</u>	<u>Site</u>	<u>School</u>
September 21	Walpole	Walpole South
22		
23		
24	Walpole	Jarvis
25	Walpole	Walpole North
26		
27	Walpole	Dunnville
28		
29		
30	Longwoods	Delaware
October 1	Longwoods	Parkview
2	Longwoods	Our Lady of Lourdes, Parkview
3		
4	Etobicoke	Millwood
5	Etobicoke	Millwood
6		
7		
8		
9	Etobicoke	Mill Valley
10		
11	Longwoods	Our Lady of Lourdes, Delaware, Caradoc South, A.E. Duffied
12	Longwoods	Caradoc Central
13		
14		
15	Etobicoke	Wellesworth
16	Etobicoke	Broadacres
17	Scarborough	John A. Leslie
18	Scarborough	Birchcliff, Fairmont
19	Scarborough	Chine Dr., Cliffside
20		
21		
22		
23		
24	Windsor	General Brock
25	Windsor	Marlborough
26		
27		
28		
29		
30	Walpole	St. Cecelia's/St. Michael's
31		

TABLE 1 (continued)

<u>Date</u>		<u>Site</u>	<u>School</u>
November	1	Toronto	St. Michael's, Park St.
	2		
	3		
	4		
	5		
	6		
	7	Toronto	Regent Park
	8	Toronto/Windsor	Church St. / H.D. Taylor, St. Edward
	9	Toronto/Windsor	St. Paul / St. Francis, St. James
	10		
	11		
	12	Toronto	St. Paul, Regent Park

TABLE 2
CONSENTS AND REFUSALS BY SITE

Site	# of Consent Forms Sent	(-) # of Parent Refusals	(-) # of Child Refusals, Child Absent	(-) # of Consents Not Returned	Total # of School- Children Tested	(+) # of Siblings Tested	Total Number Tested	Average Consent Rate
<u>Urban</u>								
Windsor	436	23	10	194	209	13	222	48%
Toronto	<u>549</u>	<u>22</u>	<u>10</u>	<u>337</u>	<u>180</u>	<u>3</u>	<u>183</u>	<u>33%</u>
	985	45	20	531	389	16	405	41%
<u>Suburban</u>								
Scarborough	434	69	2	164	199	9	208	46%
Etobicoke	<u>524</u>	<u>86</u>	<u>3</u>	<u>147</u>	<u>288</u>	<u>22</u>	<u>310</u>	<u>55%</u>
	958	155	5	311	487	31	518	51%
<u>Rural</u>								
Walpole	330	65	5	54	206	22	229	62%
Longwoods	<u>262</u>	<u>37</u>	<u>3</u>	<u>77</u>	<u>145</u>	<u>19</u>	<u>163</u>	<u>55%</u>
	<u>592</u>	<u>102</u>	<u>8</u>	<u>131</u>	<u>351</u>	<u>41</u>	<u>392</u>	<u>59%</u>
TOTAL	# 2535	302	33	973	1227	88	1315	50%
	==	==	==	==	==	==	==	==
%		11.9%	1.3%	38.4%	48.4%	3.5%	51.9%	

NOTE: This table includes all children tested (N=1315)
of whom 1269 were six and younger and 46 were
seven or older (mostly siblings).

TABLE 3
DISTRIBUTION OF BLOOD LEAD LEVELS
ABOVE THE "ALERT" LEVEL OF 20 ug/dl
IN THE TOTAL SAMPLE

	Blood Lead Level			
Site	.97-1.20 umol/L (20-24 ug/dl)	1.21-1.44 umol/L (25-29 ug/dl)	≥1.45 umol/L (≥30 ug/dl)	Number Tested
<u>Urban</u>				
Windsor				
N	7	1	2	222
% per site	3.2%	0.5%	1.0%	
Toronto				
N	10	4	-	183
% per site	5.5%	2.2%	-	
<u>Suburban</u>				
Scarborough				
N	4	3	2	208
% per site	1.9%	1.4%	0.9%	
Etobicoke				
N	7	2	1	310
% per site	0.3%	0.6%	0.3%	
<u>Rural</u>				
Walpole				
N	9	-	3	229
% per site	3.9%	-	1.3%	
Longwoods				
N	2	-	-	163
% per site	1.2%	-	-	
Total				
N	39	10	8	1315
% across sites	<u>2.9%</u>	<u>0.8%</u>	<u>0.6%</u>	<u> </u>

CHAPTER 4.0 PARENT INTERVIEWS — RISK FACTOR QUESTIONNAIRE

4.1 Questionnaire Development

Previous research has demonstrated a number of residential, occupational and lifestyle factors which appear to be related to blood lead levels. These variables include:

- o demographic variables: the composition of the family, socio-economic status and the age of the child;
- o residential variables: the age of the house, the condition of interior and exterior paint, presence of lead pipes and residential proximity to traffic and industry;
- o lifestyle factors: home-gardening, hobbies, such as soldering and working with stained glass, presence of pets in the household, and the extent to which the child demonstrates pica; and
- o occupational factors: adult occupational exposure to lead.

Questionnaires used in previous studies of lead in children were examined for content and format. These questionnaires included those used by the Toronto Department of Health in previous research on lead, as well as that used during the European Community Screening Program For Lead in 1981.²⁵ These instruments and information derived from literature review helped to identify factors to be examined in the interviews and to formulate questions.

The questionnaire was field-tested by six interviewers in four sites around the Province (Scarborough, Etobicoke, Walpole, and London). Field test results showed the questionnaire to be essentially workable with some minor revisions which took into account those families living in apartments and for whom inspection of basement plumbing was impractical. The questionnaire is attached as Appendix H.

4.2 Training Interviewers and Pretesting

Twelve interviewers carried out interviews for this study, two for each site. Each interviewer had prior experience in survey research studies.

Interviewer training consisted of familiarization with the study and specific questionnaire items, followed by role-playing exercises during which each interviewer practised conducting an entire interview with another interviewer. In addition to receiving instructions on conducting the interview and coding the questionnaire, each interviewer was trained in the examination of waterpipes for lead. A number of pipes, including copper, plastic, galvanized steel and lead, were obtained through a hardware supply store and the interviewers examined them. The most successful method of determining whether or not pipes were made of lead was found to be tapping the pipe with a metal object, such as a set of keys and listening for the characteristic "dead" sound. Interviewers were instructed to be liberal in their application of the code "combination with lead" for coding the kind of pipes found in residences, particularly when renovations, including work on pipes, had occurred.

Interviews with parents occurred as soon as all blood sampling was completed in each site. Interviewers did not experience any substantial difficulties in arranging interviews with the families since parents had been informed of and had consented to home interviews when they signed the consent form for the blood test. Interviewers were instructed to identify themselves by name and to indicate that the study was being conducted by A.R.A. Consultants on behalf of the Ministry of Health. Interviews were conducted at the home and usually took about forty-five minutes. In order to eliminate bias on the part of the interviewers, individual test results for children were not known. Therefore, interviewers were unable to discuss the implications of particular test results with the parents. They could often discuss the

general issues of the study, however, and encouraged parents with difficult questions to telephone the researcher in charge of the study.

Interviewing began in the Walpole, Scarborough, Etobicoke and London areas by the second week in October, and in Windsor and Toronto by the first and second weeks in November, respectively. All interviews were completed by November 30th.

4.3 Sampling For Interviews

For each site, a stratified random sampling plan was devised in order to sample 133 children per site (one-sixth of the sample of 800 interviews). Ideally, an equal number of children who were aged six, five, four, and under four was to be selected for parent interviews (thirty-three in each age category). However, in many sites, there were fewer than 33 four-year-olds or children younger than four. In these sites, the decision was made to over-sample children from the next highest age group: that is, if there were only twenty four-year-olds at a site but a larger number of five-year-olds and six-year-olds, an additional 13 children were selected for interviews from the five-year-old group.

Problems in balancing the sample size for each age group were most acute for children aged four years or less. Most children entering kindergarten are four years and six months or older, so that a substantial proportion of youngsters were five years old at the time of testing. In addition, there was a junior kindergarten class in only one school in Windsor and one school in Walpole. There were no junior kindergarten classes in Longwoods.

Efforts were made to sample younger siblings of children to be tested while the nurses were at the school. There were younger siblings tested at every site. All school children with younger siblings were included in the sampling plan for parent interviews because of the small number of younger siblings. The sampling plan is presented in Table 4.

Not all schools in each site were included in the testing. In Etobicoke and Scarborough, the two separate schools were not included in the testing, since it appeared that adequate numbers of children would be tested at these sites. In Toronto, one school was dropped because children attending classes at the school came from all parts of the city.

TABLE 4

SAMPLING PLAN BY SITE

	<u>3 Years or Less</u>	<u>4 Years</u>	<u>5 Years</u>	<u>6 Years</u>	<u>Total</u>
Windsor					
N possible	13	19	93	92	222
N interviewed	9	16	69	41	135
N refused, moved, wrong age	4	3	4	4	
Toronto					
N possible	14	45	55	62	183
N interviewed	14	41	47	29	134
N refused, moved, wrong age	-	4	6	10	
Scarborough					
N possible	31	66	55	56	206
N interviewed	22	49	30	33	134
N refused, moved, wrong age	9	2	3	1	
Etobicoke					
N possible	36	82	104	76	298
N interviewed	32	35	34	31	132
N refused, moved, wrong age	4	3	-	2	
Nanticoke-Walpole					
N possible	8	18	102	76	204
N interviewed	8	13	66	46	135
N refused, moved, wrong age	-	5	4	1	
Longwoods					
N possible	17	18	52	73	160
N interviewed	14	18	51	52	135
N refused, moved, wrong age	3	-	1	-	

CHAPTER 5.0 AIR, WATER AND SOIL SAMPLING METHODS

This chapter discusses the sampling plan and measures of lead in air, water and soil for each site.

5.1 Air Sampling and Analysis

5.1.1 Interpretation of Air Sampler Data

Results of analyses of ambient particulate lead concentrations were reported by the Ministry of the Environment for the period August to December, 1984 for samplers at all sites except for Longwoods, which had no data for December, and Walpole, which did not have information for August. Like blood lead levels, air lead levels tend not to have a normal distribution. Data were transformed logarithmically for analytic purposes.

The results of air sampling are presented and discussed in Chapter 6.

5.1.2 Selection of Data Points

Although data were available for up to five months for most sites, the decision was made to use only the data reported for the month that blood testing in the schools took place for analyses including blood lead levels, so as to more accurately represent recent actual exposure levels of children. Ambient air lead values for September were therefore used for the Longwoods and Walpole schools, while the October figures were used for schools at the other sites, and two Toronto schools used the November figures.

5.2 Sampling Plan -- Water

Drinking water from municipal sources usually has a very low concentration of lead but it can increase during distribution to the consumer by additions from: a) the water mains; b) the house plumbing; and c) the service connection that joins the house plumbing to the mains. With the exception of a very few mains of small diameter, municipal water mains in Ontario are not made of lead and have no lead in direct contact with the water. House plumbing and service connections, however, frequently contain some lead pipe or some lead based products.

The leaching of lead into drinking water is a function of the exposure and the aggressiveness of the water. Soft water (low alkalinity and hardness) tends to be more aggressive and more leaching of lead into the water would be expected. The water at all the test locations in this survey was hard, so minimal leaching of lead was expected.

Houses built in the 19th and 20th centuries were often equipped with lead pipes. This practice has not been permitted under current building codes since 1958 and most buildings have had their lead pipes replaced. Previous studies in the City of Toronto on lead in drinking water reported only a few dwellings that still had lead pipes. Water can still be exposed to lead in new plumbing system due to the lead/tin solder used to join copper pipes. The amount may be extensive where large amounts of solder was used in work done by an amateur or inexperienced plumber.

The most extensive exposure of drinking water to lead is through the use of a lead service connection which joins the individual plumbing system to the city watermain. These have been used extensively and many are still in service. Lead service connections normally only create a problem if the

water is aggressive and if they are exceptionally long. New and many renovated houses have service lines made of flexible copper or plastic pipe.

Lead in drinking water may vary substantially from building to building on the same street, depending on such factors as the skill of the plumber employed to do work on a particular house, or the age of the plumbing.

It was decided to take water samples from each school which could yield data on lead levels in the water supply generalizable to each site. However, data on lead in pipes of individual residences were collected from parent interviews and inspection of pipes by interviewers. Interview data on this point are, of course, indirect, with the only direct measure of water lead levels being from samples collected from each school.

5.3 Water Sampling and Analysis

A researcher from A.R.A. Consultants was trained in water collection methodology by Barringer-Magenta Laboratories, the firm which was contracted to analyse the water for lead. Acid-washed plastic bottles for sampling were supplied by the laboratory. Two samples were taken at each school: the first was taken as the first draw of the day; and the second, after the tap was allowed to run for five minutes. This method allows comparisons to be made between water which has been standing in the pipes all night and, consequently, has picked up lead from sources such as lead connectors to the city system and lead/tin-soldered pipes. When the water is allowed to run, the standing water is flushed through the pipes and fresh water enters from the city system. The second draw reflects the lead in the city water system.

The researcher visited each school the day before the water samples were to be collected, dropping off the bottles with the custodian, who, in every case, was the first person to use the water system in the morning. The researcher noted the location of the tap to be used for the sample, and its distance from the main pipe from the city system. The next day, the researcher picked up the filled bottles and transported them to the Barringer-Magenta labs in Toronto for analysis. When it was not possible to transport the bottles within eight hours, acid supplied by Barringer-Magenta was added to the bottles which were refrigerated and transported the next day.

Water samples were analysed by an atomic absorption spectrophotometer equipped with a graphite furnace. A description of the water analysis technique used by Barringer-Magenta is in Appendix J.

5.4 Sampling Plan -- Soil

The amount of lead in soil has particular significance for young children who, through their play activities outdoors, come into frequent contact with soil in playgrounds and yards. For younger children, mouthing behaviour and hand-mouth contact is relatively frequent. The correlation between soil lead and air lead is usually positive, although the accumulation of lead in the soil may be more a reflection of total past emission accumulations than current air lead levels. This is particularly the case near point-sources where abatement efforts have been instituted.

The original sampling plan had called for soil samples to be collected from a random sample of those households reporting large unsodded patches in their yards or the presence of vegetable gardens. In order to sample from households randomly, however, it would have been necessary to wait until all

of the parent interviewing was completed at each site. Since the bulk of interviewing took place during the month of November, the ground would have been frozen by the end of the interviewing, making soil sampling no longer possible. Therefore, soil samples were obtained during November from all of the school-yards of the schools that participated in the study.

5.5 Soil Sampling and Analysis

Soil sampling was conducted by the Phytotoxicology Section of the Ministry of the Environment. Samples were collected from a minimum of three locations in unpaved unsodded play areas of each school-yard. All samples were collected from a 0-5 cm depth. Where soil conditions allowed, samples were collected using a stainless steel soil core of approximately 2 cm diameter, with each sample consisting of a minimum of ten 0-5 cm cores. Where soils were either hard-packed or very loose (sandy), samples were collected using a stainless steel trowel. Sampling equipment was cleaned between sites. Samples were collected in labelled polyethylene bags for transportation to the phytotoxicology laboratory for processing.

Soil samples were dried and sieved before being submitted for analysis to the Ministry of the Environment Laboratory for lead testing. The Ministry of the Environment Laboratory routinely verifies their results by performing repeat analyses on the same samples. A technical description of the analysis of soil samples is presented in Appendix I.

CHAPTER 6.0 RESULTS FOR AIR, WATER AND SOIL LEAD

This chapter discusses the results of analyses of air, water and soil lead.

6.1 Findings for Lead in Air

6.1.1 Air Lead Levels for All Sites

Previous studies have reported that air lead levels in the range of 0.5 to 1.5 $\mu\text{g}/\text{m}^3$ are most commonly found in urban areas²¹, while values less than 0.5 are considered to be low values typical of rural areas. As can be observed from examination of Table 5, there are differences between sites in the amount of lead in air. The Toronto site had a higher average air lead level than any other site, followed by the Windsor site. Both urban sites also had higher maximum levels than did other areas. The two suburban sites were lower than the urban sites, and the two rural sites had very low readings, at or below the threshold of detection.

In addition to reported ambient lead levels, the average percentage of lead in ambient air attributable to vehicle exhaust was calculated by means of a formula based on the percentage of lead to bromine in the samples tested.³⁰ Since bromine, like lead, is added to gasoline, the extent of its presence can be used as a measure of the extent to which lead measured by air samplers can be attributable to automobile exhaust. For the present study, the percentages of lead in the air attributable to vehicle exhaust were Toronto, $85\% \pm 5\%$; Windsor, $80\% \pm 5\%$; Etobicoke, $73\% \pm 5\%$; Walpole, $67\% \pm 5\%$; and Longwoods, $77\% \pm 5\%$. Measurements for Scarborough were not available.

The higher figures for the urban sites may be indicative of the higher traffic densities near the area of the samplers. The Toronto sampler was located within two blocks of the Gardiner Expressway, the Windsor sampler was within six blocks of two heavily travelled major urban roads and within six blocks of an expressway. Both of the suburban air samplers were located in residential areas with little traffic, although they were both located

within six blocks of four-lane suburban arteries. The Longwoods sampler was located in a conservation area, approximately one and one-half kilometers from a rural two-lane highway, and the sampler in Nanticoke - Walpole was located in a similar setting near Nanticoke. The air lead results indicate that there was a higher level of lead for the urban than for the suburban or rural sites, and that a larger proportion of the lead in the air could be attributed to automobile exhaust.

6.1.2 Rural/Suburban/Urban Effects

The geometric means for rural, suburban and urban air lead concentrations were 0.1, 0.2 and 0.4 $\mu\text{g}/\text{m}^3$, respectively. Wilcoxon tests comparing rural with suburban air levels, and suburban with urban air lead levels, are significant. In analysing the effect of air lead, it is important to remember that air lead level is confounded with site, since there is only one air lead value (the measurement corresponding to the month of testing) for each site. All levels in this study were below the Ministry of the Environment's air quality criterion of 2.0 $\mu\text{g}/\text{m}^3$ calculated as a geometric mean for a 24 hour period.

6.1.3 Environment Canada Data

With the assistance of the Environmental Protection Service of Environment Canada, it was possible to assemble information on the average lead content of leaded gasoline manufactured in Ontario. In addition, Environment Canada also carried out a retail outlet sampling program which tested the lead content of gasoline sold at a number of gas stations at five of the six sites. These data, although not part of the data base of risk factor analysis for the current study, present information relevant to the environmental context in which the study took place (Table 6).

6.1.4 Traffic Density

In addition to data provided on air lead levels by the Ministry of the Environment, data on traffic density for each site was also assembled for the study. These data were collected from published data on traffic volumes

on provincial highways compiled by the Ministry of Transportation and Communications (MTC) for 1983,²² and from discussions with Traffic Engineering Departments of particular sites. The measure used is the Annual Average Daily Traffic (AADT) which is based on continuous sampling of traffic volumes for specific sites. The figures presented are for the location reported by the Ministry of Transportation and Communications or municipal sources nearest to each school (Table 7).

Examination of the data indicates that rural sites have substantially lower traffic densities than do the urban or suburban sites, with suburban sites resembling the urban sites. These data serve as another source of evaluating the available information on air lead since vehicular traffic using leaded gasoline is a major contributor of lead to air.

TABLE 5

AIR LEAD LEVELS FOR ALL SITES
($\mu\text{g}/\text{m}^3$)

<u>Site</u>	<u>Aug.</u>	<u>Sep.</u>	<u>Oct.</u>	<u>Nov.</u>	<u>Dec.</u>	<u>Mean</u>
Windsor						
Arithmetic Mean	0.3	0.2	0.4	0.4	0.3	0.3
Geometric Mean	0.2	0.2	0.3	0.3	0.2	0.2
Maximum	0.4	0.4	0.8	1.1	0.7	
Minimum	0.1	0.1	0.1	0.1	0.1	
Toronto						
Arithmetic Mean	0.9	0.7	0.6	0.9	0.6	0.7
Geometric Mean	0.8	0.7	0.5	0.7	0.6	0.7
Maximum	1.3	1.1	1.1	2.6	1.2	
Minimum	0.2	0.3	0.4	0.3	0.2	
Scarborough						
Arithmetic Mean	0.2	0.2	0.2	0.2	0.2	0.2
Geometric Mean	0.2	0.2	0.2	0.1	0.1	0.2
Maximum	0.4	0.4	0.6	0.3	0.3	
Minimum	0.1	0.1	0.1	0.1	0.1	
Etobicoke						
Arithmetic Mean	0.3	0.3	0.3	0.1	0.2	0.2
Geometric Mean	0.3	0.3	0.3	0.1	0.1	0.2
Maximum	0.7	0.5	0.6	0.1	0.5	
Minimum	0.1	0.1	0.1	0.1	0.1	
Nanticoke-Walpole						
Arithmetic Mean	-	0.1	0.1	0.1	0.1	0.1
Geometric Mean	-	0.1	0.1	0.1	0.1	0.1
Maximum	-	0.1	0.1	0.2	0.1	
Minimum	-	0.1	0.1	0.1	0.1	
Longwoods						
Arithmetic Mean	0.1	0.1	0.1	0.1	-	0.1
Geometric Mean	0.1	0.1	0.1	0.1	-	0.1
Maximum	0.1	0.1	0.1	0.1	-	
Minimum	0.1	0.1	0.1	0.1	-	

TABLE 6

LEAD IN LEADED GASOLINE

Refinery Sampling of Lead Content in Leaded Gasoline

Refinery	Location	Date Sampled	Lead Content g/l
A	Nanticoke	Jan. 7, 1985	0.34
B	Oakville	Jan. 8, 1985	0.61
C	Mississauga	Jan. 8, 1985	0.28
D	Port Credit	Jan. 11, 1985	0.22
E	Sarnia	Jan. 10, 1985	0.32
F	Sarnia	Jan. 10, 1985	0.44
G	Corunna	Jan. 10, 1985	<u>0.48</u>
Average Lead Content			0.38

Retail Outlet Sampling Program

Site	Date Sampled	Lead Content of Regular Leaded Gasoline	Number of Stations
Scarborough	Sep. 13, 1984	0.482 g/l	10
Longwoods	Sep. 19, 1984	0.510 g/l	10
Windsor	Sep. 28, 1984	0.527 g/l	10
Etobicoke	Sep. 11, 1984	0.454 g/l	10
Toronto	Sep. 10, 1984	0.460 g/l	10

TABLE 7

Page 1

TRAFFIC DENSITIES BY SITE

Windsor

<u>School</u>	<u>AADT</u> ¹ *	<u>Location Description</u>
Marlborough Public School	6,849	Tecumseh Road, east of Prince
General Brock	11,247	Mill Street and Brock Street
Dr. H.D. Taylor	12,405	Tecumseh Road and Campbell
St. James	5,800	Prince Road
St. Francis	11,247	Detroit Street and Sandwich Street
St. Edward	5,000	Prince Road and King Street

Toronto

<u>School</u>	<u>AADT</u> **	<u>Location Description</u>
Church St. School	12,450	York Street and Front Street
Park Junior School	14,700	Queen Street and Jarvis Street
Regent Park Junior School	15,000	Queen Street and Jarvis Street
St. Michael On The Lane	15,000	Queen Street and Jarvis Street
St. Paul	15,000	Queen Street and Jarvis Street

Note 1 - Annual Average Daily Traffic (AADT): the average 24-hour 2-way traffic for the period, January 1st to December 31st.

Most recent figures available for these sites were obtained from:

* Traffic Engineering Department, City of Windsor

** Department of Roads and Traffic, Municipality of Metropolitan Toronto.

TRAFFIC DENSITIES BY SITE

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Scarborough

<u>School</u>	<u>AADT</u>	<u>**</u>	<u>Location Description</u>
Fairmount Junior School	13,500		Kingston Road and McCowan
Chine Drive Elementary School	13,750		Kingston Road and Midland
John A. Leslie	13,750		Kingston Road and Midland
Cliffside Junior School	13,750		Kingston Road and Kennedy
Birch Cliff	13,750		Kingston Road and Kennedy

Etobicoke

<u>School</u>	<u>AADT</u>	<u>**</u>	<u>Location Description</u>
Mill Valley Junior School	14,600		Burnhamthorpe Road and Highway 427
Broadacres Junior School	14,600		Burnhamthorpe Road and Highway 427
Wellesworth Junior School	14,600		Burnhamthorpe Road and Highway 427
Millwood Junior School	14,600		Burnhamthorpe Road and Highway 427

Most recent figures available for these sites were obtained from:

** Department of Roads and Traffic, Municipality of Metropolitan Toronto

TRAFFIC DENSITIES BY SITE

Page 3

Nanticoke-Walpole

<u>School</u>	<u>AADT</u>	****	<u>Location Description</u>
Walpole North Hagersville, Ontario	6,100		Highway 6 and Haldimand - Norfolk Road 9 - Hagersville
Walpole South Nanticoke, Ontario	3,900		Highway 6 and Highway 24
Jarvis Jarvis, Ontario	2,300		Highway 6 and Nanticoke - formerly Jarvis
Dunnville Central Dunnville, Ontario	3,800		Niagara/Haldimand Norfolk Reg. Line Dunnville, Lot 5-6
St. Cecilia's Port Dover, Ontario	4,900		Highway 6 and Nanticoke - Port Dover - Mill Rd.
St. Michael's Dunnville, Ontario	3,800		Niagara/Haldimand Norfolk Reg. Line Dunnville, Lot 5-6

Most recent figures available for this site were obtained from:

**** Ministry of Transportation and Communications, City of Burlington

TRAFFIC DENSITIES BY SITE

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Longwoods			
<u>School</u>	<u>AADT</u>	***	<u>Location Description</u>
Delaware Elementary School Delaware, Ontario	2,500		Highway 2 and Highway 402 IC
Caradoc Central Mount Bridges, Ontario	5,500		Highway 81 and Highway 2, Delaware
Parkview Elementary Komoka, Ontario	5,000		Highway 402 and Middlesex Road 14 IC 82
Caradoc South Melbourne, Ontario	2,250		Middlesex Road 9 - Melbourne
A.E. Duffield Lambeth, Ontario	4,500		Highway 402 and Highway 4 IC 98
Our Lady of Lourdes Delaware, Ontario	2,500		Highway 2 and Highway 402 IC

Most recent figures available for this site were obtained from:

*** Provincial Highways Traffic Volumes: King's Highways, Secondary Highways and Tertiary Roads, Ministry of Transportation and Communications, June 1983

6.2 Findings for Lead in Water

6.2.1 Interpretation of Results

Two sets of results were reported for the analysis of water samples. The first figure reflects the amount of lead in the sample that was the first draw of the day and the second reflects the amount of lead in the second draw after the tap had been running for five minutes. There can be substantial variability in results from first-draw and second-draw samples. One researcher, for example, reporting on a survey of approximately 1000 U.K. households with lead pipes, noted that the ratio of lead concentration in daytime running water samples to first-draw samples ranged from 0.25 to 2.0.²³ Lead levels in the first-draw sample can be attributed to lead present in the pipes or connectors for that particular building, while lead concentrations in the second-draw running water sample reflect the lead in the municipal water supply.

The current Ontario Maximum Acceptable Concentration (MAC) for lead in drinking water is 50 ug/L. This is the maximum concentration allowed in drinking water on a continuous basis at the free-flowing tap of the consumer. No lead level reported was above that figure, and most reported levels were very low.

Three schools (in Longwoods, Scarborough and Toronto) had moderately high lead levels (>30 ug/L) in the first draw samples, while the second draw readings indicated minimal lead levels.

All but one of the schools reported having copper, galvanized iron or steel, or plastic pipes. The one school that reported the presence of lead pipes had slightly elevated lead levels in the water samples: 15 ug/L for the first draw and 18 ug/L for the second draw. (See Table 8 for water lead levels for each site.)

6.2.2 Site Differences for Water Lead Levels

In order to test for differences in water lead levels across sites, a Kruskal-Wallis non-parametric analysis of variance was computed for water lead values. The values of the test statistic were $X^2=6.73$ (df=5) for the first draw (standing water) sample, and $X^2=4.05$ (df=5) for the second draw (running water) sample, neither of which was statistically significant, indicating that there were no significant differences in water lead levels across the sites. It should be noted that because of the small number of water lead measurements per site (one per school), the statistical power of this test to detect small differences is much less than for tests of differences in blood lead.

TABLE 8

WATER LEAD LEVELS FOR ALL SITES

	First Draw (Pb ug/L)	Second Draw (Pb ug/L)		First Draw (Pb ug/L)	Second Draw (Pb ug/L)
<u>Urban Sites</u>					
WINDSOR			TORONTO		
School #1	1	<1	School #1	8	5
" #2	5	<1	" #2	4	<1
" #3	1	2	" #3	5	1
" #4	<1	<1	" #4	36	1
" #5	7	7	" #5	4	7
" #6	<1	<1			
Mean	2.5	1.8	Mean	11.4	2.9
<u>Suburban Sites</u>					
SCARBOROUGH			ETOBICOKE		
School #1	32	<1	School #1	9	<1
" #2	7	<1	" #2	15	18
" #3	12	<1	" #3	2	1
" #4	2	<1	" #4	6	<1
" #5	11	2			
Mean	12.8	1.2	Mean	8.0	5.0
<u>Rural Sites</u>					
WALPOLE			LONGWOODS		
School #1	4	3	School #1	<1	<1
" #2	<1	<1	" #2	21	3
" #3	11	<1	" #3	<1	<1
" #4	13	<1	" #4	<1	1
" #5	11	<1	" #5	34	<1
" #6	3	2	" #6	1	2
Mean	7.1	1.2	Mean	9.6	1.3

6.3 Findings for Lead in Soil

6.3.1 Interpretation of Results

Lead levels for soil are reported in parts per million (ppm, dry weight). According to the Phytotoxicology Section of the Ministry of the Environment, "upper limit of normal" lead levels in surface soil in urban areas not subjected to point source lead emissions is 500 ppm. The corresponding rural level is 150 ppm. These levels are based on Ontario data and represent three standard deviations from the mean.

Results are reported in Table 9 first with all soil samples included, and then with sandy and baseball diamond soils excluded. Sandy soils typically contain less lead than other soils and may also consist of clean imported soil. The exclusion of sandy soils thus results in slightly higher average soil lead levels for the remaining soil samples.

The two urban sites had the highest levels of soil lead in school playgrounds, although average values were well below the upper limit for an urban site. There was a reversal in the anticipated pattern for the other sites: the rural Walpole site was slightly higher than suburban Scarborough, while suburban Etobicoke was just slightly lower than rural Longwoods. Examination of soil lead levels for the Walpole site revealed that the high site average was attributable to particularly high readings in the schools in the town of Dunnville. When Dunnville schools were excluded, the Walpole site was lowest of all sites in soil lead.

6.3.2 Site Differences for Soil Lead Levels

In order to test for differences in soil lead levels across sites, a Kruskal-Wallis non-parametric analysis of variance was computed on soil lead values. The test was first computed on the soil lead values for sites

including all samples, then again on values for sites excluding samples taken from baseball diamonds or sandy soils. For the analysis of all the soil lead samples, including those from sandy soils, the value of the test statistic was 16.35 ($df = 5$), which was statistically significant ($p < .01$). When samples from sandy soils from each site were excluded from the analysis, the test statistic was 14.75 ($df = 5$); this was statistically significant ($p < .05$), although the differences between sites were somewhat less pronounced.

6.3.3 Air Lead Level and Soil Lead Level

The Spearman correlation of soil lead and air lead is 0.442 (0.479 omitting sandy soil), and both correlations are significant ($p < .01$). The variable distances between the single air sampler in each site and the several schools per site at which soil lead determinations were performed should be expected to produce a conservative estimate of the correlation between soil and air lead measurements.

TABLE 9

SOIL LEAD LEVELS FOR ALL SITES

	Soil Lead Levels (ppm,* dry weight) (0-5 cm depth)						
<u>Sites</u>	<u>All Samples Included</u>			<u>Sandy and Baseball Diamond Soils Excluded</u>			
	Mean <u>+</u> S.D.	Range	N	Mean <u>+</u> S.D.	Range	N	
Urban							
Windsor	54 42	4-180	30	72 39	23-180	20	
Toronto	48 32	11-120	17	54 36	11-120	12	
Suburban							
Scarborough	20 15	4- 81	23	22 16	6- 81	19	
Etobicoke	12 9	3- 28	17	20 8	6- 28	8	
Rural							
Longwoods	13 10	<3- 51	26	15 10	7- 51	17	
Walpole	25 41	<3-170	29	42 55	7-170	14	
Walpole (excluding Dunnville)	11 8	<3- 33	20	16 9	7- 33	10	

* ppm = ug/gm = mg/kg

TABLE 9A

SOIL LEAD LEVELS FOR ALL SITES
BY SCHOOL

	All Schoolyard Samples (ppm)	Samples Without Sandy Soil (ppm)		All Schoolyard Samples (ppm)	Samples Without Sandy Soil (ppm)
<u>Urban Sites</u>					
WINDSOR			TORONTO		
School #1	51	80	School #1	47	48
" #2	69	88	" #2	43	51
" #3	36	51	" #3	30	27
" #4	25	38	" #4	33	37
" #5	75	83	" #5	<u>115</u>	<u>115</u>
" #6	<u>77</u>	<u>93</u>			
Mean	54	72	Mean	48	54
<u>Suburban Sites</u>					
SCARBOROUGH			ETOBICOKE		
School #1	14	20	School #1	7	8
" #2	22	22	" #2	12	22
" #3	19	27	" #3	19	23
" #4	15	15	" #4	<u>14</u>	<u>25</u>
" #5	<u>25</u>	<u>29</u>			
Mean	20	22	Mean	12	20
<u>Rural Sites</u>					
WALPOLE			LONGWOODS		
School #1	10	10	School #1	16	19
" #2	8	14	" #2	10	11
" #3	20	22	" #3	11	9
" #4	61	124	" #4	13	16
" #5	4	4	" #5	19	31
" #6	<u>53</u>	<u>92</u>	" #6	<u>6</u>	<u>8</u>
Mean	25	42	Mean	13	15

CHAPTER 7.0 STATISTICAL METHODOLOGY FOR RISK FACTOR ANALYSIS

This chapter describes the statistical methods applied to analyse the data in this study.

7.1 Analysis Plan

Data analysis for the study involved a number of sequential steps; first to describe the data and relationships among factors, and then to determine which risk factors were related to blood lead concentrations.

It was necessary to examine overall blood lead levels of the tested children and to test for differences in the presence of risk factors among the sample.

The second step was to examine individual risk factors (such as age, or distance of the residence from industry) to determine if they were significantly related to blood lead concentrations for the children sampled. Relationships between blood lead concentrations and the measures of air lead, soil lead and water lead were evaluated for all children who had their blood lead level determined (N = 1315). The relationships between blood lead levels and the risk factors measured by the questionnaire were evaluated for those children whose families had been selected for the risk factor assessment (N = 800). Relationships between blood lead levels and risk factors were tested initially for each factor separately, without taking into account the possible effects of other risk factors. Univariate relationships between single risk factors and children's blood lead levels are artificial constructs, as no such "pure" relationships exist in the absence of other co-variables. The examination of univariate relationships was performed to identify variables that were of significance to apply in subsequent multivariate model building.

Thus, the final step was to evaluate risk factors simultaneously. This process first required modelling of the data by examining a series of regression equations to see which risk factors, in combination, were most

strongly related to blood lead concentrations. The final step in the analysis was to build a model which took into account all significant risk factors. These steps are described in more detail below.

7.2 Descriptive Analysis

In the descriptive analysis data were summarized in frequency tables, and described by geometric means and medians.

The values for blood lead were transformed to a logarithmic scale because their distribution was skewed (i.e., there were more observations on the upper end of the value range than the lower). The log-transformed data displayed a more symmetric, normal distribution and, thus, better satisfied the statistical assumptions of the analyses. Water lead and soil lead measurements also had skewed distributions and were similarly transformed.

Because the data for lead measurements had undergone logarithmic transformation, average results are presented in the form of geometric means. Geometric means are the mean values for the logarithmically transformed data, transferred back to the original scale of measurement. Because means can be easily affected by extremely high or extremely low values, median values are also presented. The median, or midpoint, is the point in the distribution of measurements at which half the values fall above and half fall below. Medians are less affected by extreme values. Geometric means and medians are presented in two measurement scales, $\mu\text{mol/L}$ and $\mu\text{g/dl}$, so that results may be easily compared with other studies.

Relationships between two continuous variables (such as soil lead and air lead) were described by Spearman and Pearson correlations. These two measures of association assess the extent to which two factors increase or decrease together. The Spearman correlation is somewhat less affected by anomalies in the distribution of the factors since it is based on ranks, rather than the actual values of the data. Values for both the Spearman and Pearson correlation coefficients are reported.

Data in the form of frequency tables (nominal data or data that was not ordered from low to high) were tested using standard chi-square methods. For example, the difference of the age distribution of the children across sites would be tested using chi-square when included in a statistical analysis. Chi-square examines whether categorical distributions between groups are statistically significant. For example, a chi-square test could be used to examine if the distribution of children living in houses versus apartments differed between boys and girls.

To test group comparisons of risk factors that were ordered (from high to low) the Kruskal-Wallis non-parametric analysis of ranks was used. This test yields a chi-square value whose significance can be obtained from a table of chi-square values. The advantage of the Kruskal-Wallis test is that it is not sensitive to extreme data values and requires few assumptions about the data. It is, thus, a robust and reliable test. When only two groups are compared, the Kruskal-Wallis test is called the Wilcoxon test.

7.3 Risk Factor Analysis

The relationships between risk factors and blood lead levels were examined in two ways: first, regression analysis of single risk factors; and, secondly, multiple regression analysis.

Regression Analysis of Single Risk Factors: To evaluate the risk factors more reliably, multiple regressions were calculated which removed the influence of site effects on blood lead differences. It became apparent in initial findings that the sites differed on blood lead levels so greatly that it was necessary to make comparisons only within each site. In effect, a multiple regression analysis which includes both site and the single risk factor in question, allows this to be done. Each potential risk factor was tested for statistical significance in this way. Only those risk factors which were associated with blood lead at the 5% probability level or greater ($p < .05$) were retained for further examination (that is, a particular result would have occurred by chance alone fewer than five times in a hundred).

Multiple Regressions: To deal with interrelationships among the risk factors, the important risk factors must ultimately be tested together in the same multiple regression analysis. When evaluating several risk factors together, two types of statistical tests for the effects of risk factors on blood lead level are possible: simultaneous and sequential.

Simultaneous Test and Sequential Tests: The simultaneous test of a risk factor measures the improvement in predicting blood lead level due to the addition of the risk factor to a regression equation which already includes the remaining risk factors. The sequential test measures the improvement in prediction due to the addition of that risk factor to a regression equation which already includes only those risk factors which are considered before it. For example, a given risk factor may have a significant p-value of .001 when its effect is measured in terms of its improvement over one or two other risk factors, but a non-significant p-value of less than .05 when measured for its improvement compared to all the other variables.

The interpretation of the two types of tests is demonstrated by considering a hypothetical pair of variables which are significantly related to blood lead and are very highly correlated to each other. The stepwise test will show the first listed variable of the pair to be significant, and the second not significant. The simultaneous test will show both variables not to be associated with blood lead, since neither offers an improvement in prediction when the other is known.

The most important test is probably the simultaneous one, but the sequential test offers some additional interpretation of the results. For example, socioeconomic status (SES) is associated with a constellation of risk factors and was entered last into the multiple regression model. This was to prevent SES from 'siphoning off' effects due to variables with which it is correlated and which were already included in the regression equation.

Selection of Variables: In order to develop succinct models, a screening procedure was followed to select the most meaningful sets of risk factors. The first step was to select only those risk factors which were statistically significant in a regression equation which included site as the only other variable. The next screening was done by including site and all risk factors related to the child's immediate home environment simultaneously in a regression equation. Only the risk factors which were significant in this analysis were retained for further regression analyses. The other screening was similar, including those risk factors related to the child's residential neighbourhood and site in a regression equation. The surviving, statistically significant neighbourhood and home environment variables were then considered in the final regression analyses.

The final regression models combined the risk factors selected by the screening procedures. Several models were constructed to interpret the data in different ways. The objective of the modelling procedure was to obtain interpretable models, rather than find a single model which accounted for the maximum variance. Comparisons between different models can be made informally by comparing F statistics for the significance of the regression models.

8.0 BLOOD LEAD IN TOTAL SAMPLE

The original sample of 1315 children for whom blood lead results were available contained forty-six children who were aged seven or older. To expedite the testing process, the procedure had been to attempt to test all children in grade one, some of whom were older than six years at the time of testing. In addition, some parents brought along older as well as younger siblings to be tested. Since the study had been designed to investigate blood lead levels of children aged six years or less, all children older than six were omitted from any analysis involving blood lead levels, leaving an analysis sample of 1269 children six or younger.

8.1 Distribution of Blood Lead

The distribution of blood lead levels and means among the 1269 children six years and younger are demonstrated in Tables 10, 11 and 12. Average blood lead levels by site and by urban-suburban-rural residence are shown.

8.2 Site Effects

Inspection of Table 10 indicates that there are notable differences between the sites, and a Kruskal-Wallis non-parametric analysis of variance resulted in a statistically significant difference attributable to site (chi-square [df = 5] = 154.2, $p < .001$). The ordering of blood lead means was not completely in line with prediction: although the two urban sites had the highest blood lead levels and the Longwoods rural site was lowest, the rural Nanticoke-Walpole site was similar to the two suburban sites. Since there was relatively light traffic density at this site, this higher-than-expected level may be attributable to other local effects.

It is noteworthy that the average lead levels for all sites taken together are substantially lower than those reported in other studies. In a study conducted by the Toronto Department of Health in 1974, children living near a lead smelter and a control group of children residing in a non-point source area of Toronto had average levels of 27 ug/dl for exposed children and 19 ug/dl for control children.¹⁶ U.S. studies of blood lead levels in young children in areas without industrial sources of lead emissions have reported values ranging from 8.2 ug/dl¹⁹ to 23.9 ug/dl.²⁰

8.3 Rural/Suburban/Urban Effects

When sites were grouped according to their designation as urban, suburban, or rural, there was a significant association between mean blood lead level and degree of urbanization, with children in urban sites having the highest mean blood lead levels, followed by children in suburban sites, and children in rural sites having the lowest levels (Table 11). The distribution of the blood lead levels by urban-suburban-rural residence is shown in Table 12.

As discussed earlier, urban/suburban/rural differences were not completely clear-cut since the Nanticoke-Walpole site was more comparable to the suburban sites than to the other rural site.

8.4 Age Effects

There were significant differences in blood lead among the age groups. Younger children tended to have higher blood lead levels than older children (Table 13 and Figure 3).

The age distribution of the sample was somewhat uneven, with more five and six-year-olds than younger children. This imbalance was due to the fact that a minority of schools had junior kindergarten classes, which are attended by four-year-olds and some three-year-olds. The majority of children aged three years or less were siblings of children tested in the classroom. Figure 2 demonstrates the age distributions for the sites.

8.5 Sex Effects

There were slightly more boys than girls in the sample (51.2% vs 48.8%). Boys had statistically significantly higher blood lead concentrations than girls (Table 14 and Figure 4).

TABLE 10
MEAN BLOOD LEAD CONCENTRATIONS
OF CHILDREN AGED SIX AND YOUNGER BY SITE

<u>Site</u>	Geometric Mean ⁺ S.D.		Median		<u>N</u>
	umol/L*	(ug/dl)	umol/L	(ug/dl)	
<u>Urban</u>					
Windsor	0.58 <u>±</u> 0.21	12.02 <u>±</u> 4.3	0.58	12.02	217
Toronto	0.58 <u>±</u> 0.20	12.02 <u>±</u> 4.3	0.55	11.37	175
<u>Suburban</u>					
Scarborough	0.50 <u>±</u> 0.18	10.36 <u>±</u> 1.9	0.49	10.15	204
Etobicoke	0.47 <u>±</u> 0.17	9.74 <u>±</u> 3.4	0.46	9.53	303
<u>Rural</u>					
Nanticoke- Walpole	0.48 <u>±</u> 0.19	9.95 <u>±</u> 3.9	0.47	9.69	210
Longwoods	<u>0.37</u> <u>±</u> <u>0.16</u>	<u>7.67</u> <u>±</u> <u>3.3</u>	<u>0.38</u>	<u>7.78</u>	<u>160</u>
Overall	<u>0.50</u>	<u>10.36</u>	<u>0.49</u>	<u>10.12</u>	<u>1269</u>
	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>

* To convert umol/L to ug/dl, divide by 0.04826.

TABLE 11

MEAN BLOOD LEAD CONCENTRATIONS BY
URBAN/SUBURBAN/RURAL RESIDENCE

<u>Site</u>	Geometric Mean $\pm$ S.D.		Median		<u>N</u>
	umol/L	(ug/dl)	umol/L	(ug/dl)	
<u>Urban</u>	0.58 $\pm$ 0.21	12.02 $\pm$ 4.4	0.56	11.60	392
<u>Suburban</u>	0.48 $\pm$ 0.17	9.95 $\pm$ 3.5	0.48	9.89	507
<u>Rural</u>	0.43 $\pm$ 0.19	8.91 $\pm$ 3.9	0.42	8.68	370
<u>Total</u>	0.50	10.36	0.49	10.12	1269

* To convert umol/l to ug/dl divide by 0.04826

TABLE 12

GEOMETRIC MEAN LEVELS AND DISTRIBUTION OF BLOOD LEAD CONCENTRATIONS BY
RESIDENCE AMONG SAMPLED ONTARIO CHILDREN AGED SIX AND UNDER

		BLOOD LEAD CONCENTRATION							Total # Children Tested	
	GEOMETRIC MEAN(±SD) (ug/dl)	umol/L	0-.23	.24-.47	.48-.71	.72-.96	.97-1.20	1.21-1.44		≥1.45
RESIDENCE		ug/dl	0-4	5-9	10-14	15-19	20-24	25-29	≥30	
<u>URBAN</u>										
# (%)	12.02(±4.4)	2 (0.5)	112 (28.6)	180 (45.9)	76 (19.4)	15 (3.8)	5 (1.3)	2 (0.5)	392	
<u>SUBURBAN</u>										
# (%)	9.95(±3.5)	13 (2.6)	250 (49.3)	194 (38.3)	31 (6.1)	11 (2.2)	5 (1.0)	3 (0.6)	507	
<u>RURAL</u>										
# (%)	8.91(±3.9)	27 (7.3)	207 (55.9)	98 (26.5)	25 (6.8)	10 (2.7)	0 (0.0)	3 (0.8)	370	
<u>TOTAL</u>										
# (%)	10.36(±4.2)	42 (3.3)	569 (44.8)	472 (37.2)	132 (10.4)	36 (2.8)	10 (0.8)	8 (0.6)	1269	

TABLE 13

DISTRIBUTION OF MEAN BLOOD LEAD CONCENTRATIONS BY AGE

Age	Geometric Mean $\pm$ S.D.		Median		N
	umol/L	(ug/dl)	umol/L	(ug/dl)	
3 year-olds or younger	0.53 $\pm$ 0.19	(10.99 $\pm$ 3.9)	0.53	11.04	144
4 year-olds	0.49 $\pm$ 0.21	(10.15 $\pm$ 4.4)	0.50	10.29	257
5 year-olds	0.50 $\pm$ 0.22	(10.36 $\pm$ 4.5)	0.50	10.39	471
6 year-olds	0.47 $\pm$ 0.17	(9.74 $\pm$ 3.5)	0.47	9.69	427

FIGURE 2

DISTRIBUTION OF AGE BY SITE

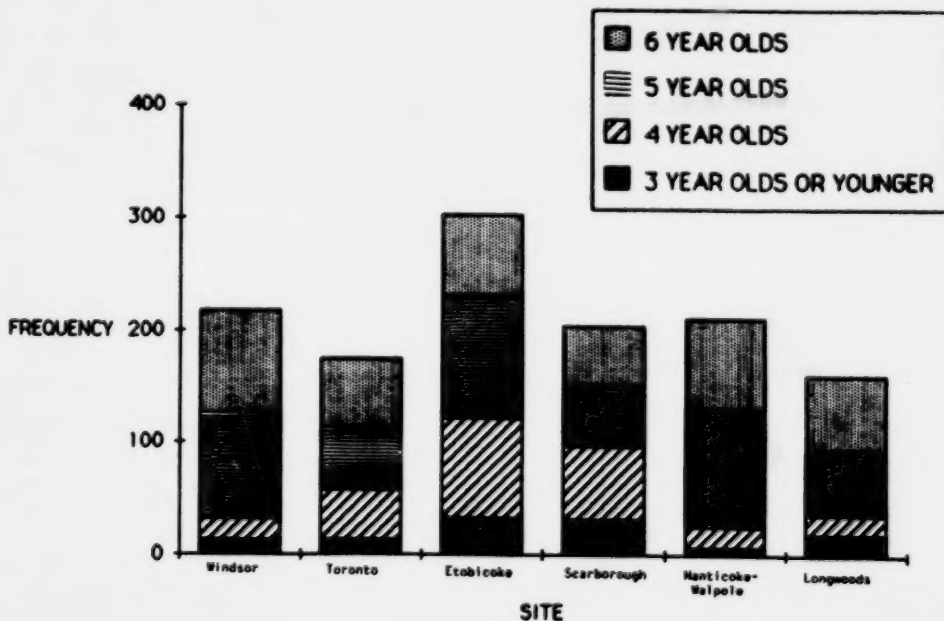


FIGURE 3

BLOOD LEAD CONCENTRATIONS BY AGE
AND SITE

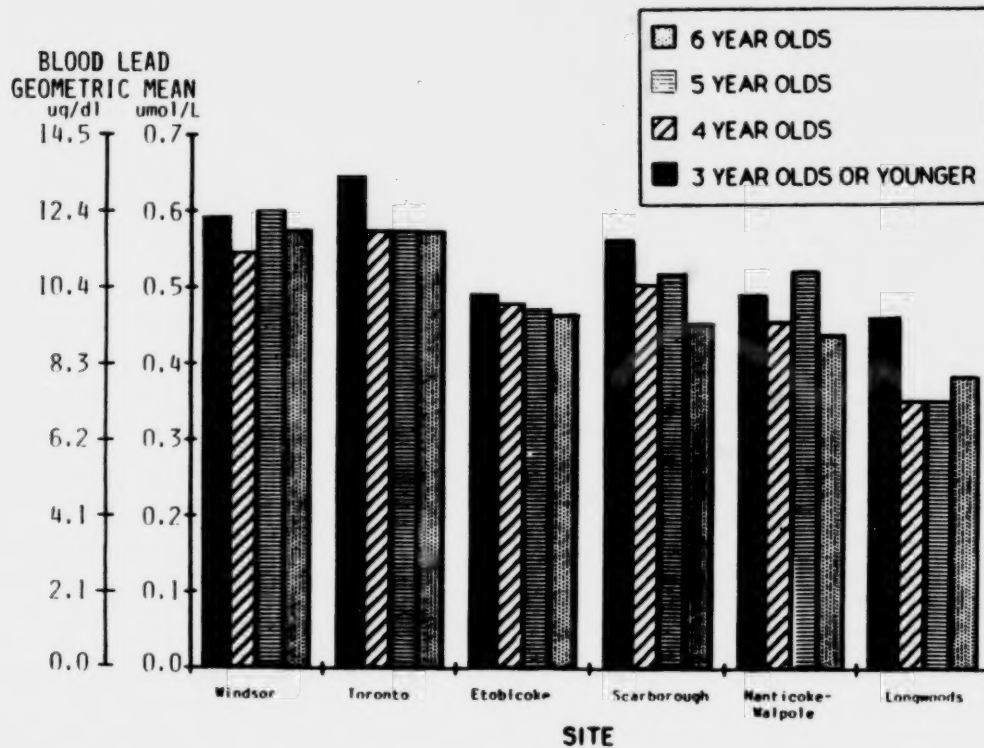
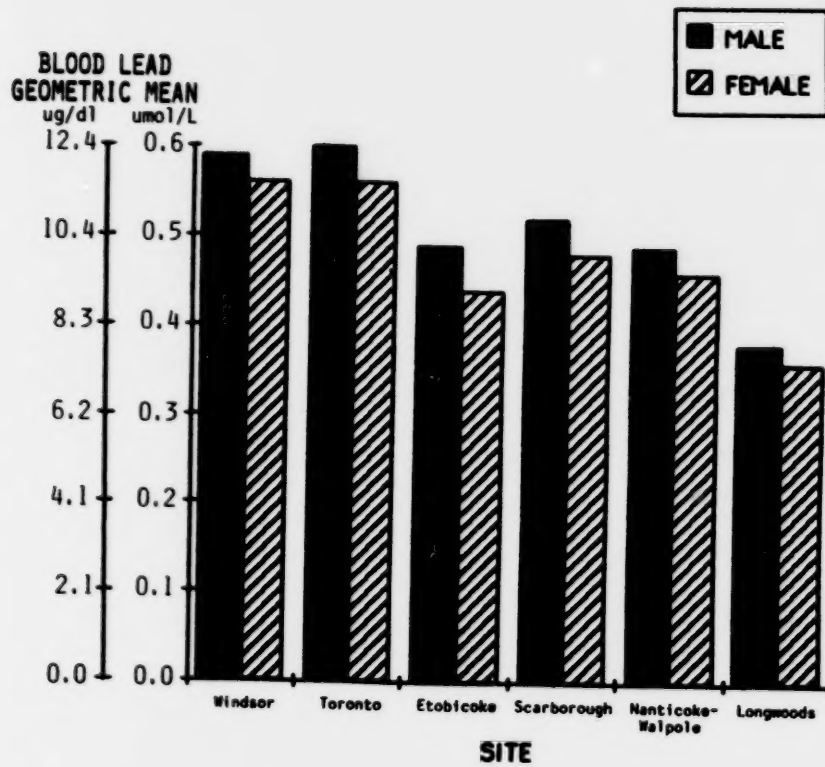


TABLE 14
DISTRIBUTION OF MEAN BLOOD LEAD CONCENTRATIONS
BY SEX AND SITE

Site	Geometric Mean		Median		N	
	umol/L	(ug/dl)	umol/L	(ug/dl)		
Windsor						
Male	.56	12.23	.57	11.81	108	
Female	.56	11.60	.56	11.60	109	
Toronto						
Male	.60	12.43	.57	11.81	83	
Female	.56	11.60	.54	11.19	92	
Scarborough						
Male	.52	10.77	.50	10.36	108	
Female	.48	9.95	.49	10.15	96	
Etobicoke						
Male	.49	10.15	.50	10.36	151	
Female	.44	9.12	.43	8.91	152	
Nanticoke -Walpole						
Male	.49	10.15	.47	9.74	123	
Female	.46	9.53	.44	9.12	87	
Longwoods						
Male	.38	7.87	.37	7.67	77	
Female	.36	7.46	.37	7.67	83	
TOTAL					1269	
Males	.51 ± 0.20	10.57 ± 4.2	.51	10.50	650	51.2%
Females	.47 ± 0.19	9.74 ± 3.9	.48	9.89	619	48.8%

FIGURE 4

BLOOD LEAD CONCENTRATIONS
BY SEX AND SITE



CHAPTER 9.0 ANALYSIS OF INTERVIEWED SAMPLE

9.1 Description of Interviewed Sample

This chapter describes the characteristics of the sample of interviewed families and relates the children's blood lead levels to risk factors as identified in the questionnaire.

The following section presents descriptive information on the families who were interviewed with the risk factor questionnaire. The reader may wish to proceed directly to Chapter 9.2 which presents the analysis of relationships between risk factors and blood lead.

The tables referred to can be found in Appendix K. These tables present the number and percentage (where appropriate) of respondents who gave various responses, and also presents the value of the chi-square test which was computed for the distribution of each risk factor for the sites. It should be noted that many of the tables have multiple cells and some with very low frequencies and should therefore be considered with caution. Chi-square tests for differences in the distribution of risk factors across sites were not used to eliminate risk factors from subsequent analysis. Instead, they document the substantial variability across sites. No attempt was made to consolidate cells or to otherwise adjust the tables to satisfy statistical requirements.

Age: As in the sample as a whole, there was a greater representation of older children (five and six-year-olds) than younger children, especially in the sites without junior kindergarten classes. Overall, there were more five-year-olds tested than any other age group. Five children were older than six years at time of testing, but because their birthdates were incorrect or missing from the consent forms, they were included in the risk

factor interview. There were significant age differences across sites. In addition, when the two sites within each residential category were tested, there were significant differences between the two urban sites, and between the two rural sites on the ages of the children tested (Table K-1).

Almost 13% of the sample were children aged three years or younger. Virtually all of these children were the younger siblings of children who had been tested in the classroom.

Sex: Across all sites, 49.4% of all children whose families were interviewed were male, while 50.6% were female (Table K-2).

Composition of Households: Most of the children lived in households with two adults present; 13% of the households were occupied by a single parent. There were wide variations across sites in the likelihood of children living in a single-parent household, with 16% of Windsor households and 44% of Toronto households being headed by a single parent, almost always the mother. There were significant differences across sites, and there were significant differences between the two urban and between the two suburban sites in the number of adults living at home (Table K-3).

The father was absent in 18% of all households, and the percentage differed significantly across sites (Table K-4). Again, these percentages were higher in Windsor (28%) and Toronto (48%); these two sites were significantly different from each other. The number of single-parent, usually mother-headed households in Toronto and Windsor, may be associated with significant social disadvantage. The majority of single-parent households, especially those headed by women, have incomes below the poverty line.

Other Children: More than half the households had other children younger than three years old and between seven and twelve years old. Only 11% had children older than thirteen years of age. Differences in the number of younger or older children in the household across sites were statistically significant (Table K-5).

Leadworkers: The number of workers reporting that they were tested for lead at work was very small (3% of fathers, and only one mother), and although very few workers described themselves as leadworkers, examination of specific occupations indicated that approximately 16% of fathers had some occupational exposure to lead. Although the sites were significantly different on this variable, there were very small differences across sites (Table K-6).

Using the index employed by the Toronto Department of Public Health, the occupations of all adults living in the household were coded for the degree of exposure to lead. Very few workers were employed in the lead industry such as lead smelters or battery plants, but there were a number of plumbers, electricians and roofers, auto mechanics, and taxi or bus drivers. Fewer mothers than fathers (2%) worked in occupations with significant exposure to lead; most women who were exposed to lead worked as bus or taxi drivers (Table K-7). Lead exposure among other household occupants as a result of employment was negligible (Table K-8).

Socioeconomic Status of Parent: In order to evaluate the socioeconomic status of the occupation of the main breadwinner in the family, the occupation of one adult in each household was ranked using a Canadian socioeconomic scale which evaluates occupations on the basis of income, education and prestige (Blishen, 1971). In most cases, the occupation of the father (or stepfather) was ranked, but in cases where the father (or stepfather) was not present, the occupation of the mother was evaluated. There are obvious difficulties in evaluating the socioeconomic status of the family solely on the father's occupation, especially in these days of two-career families, but the index of relative SES for the sample does not pretend to be anything more than a rough tool for assessing occupational differences across sites.

The Blishen index ranks occupations on a scale ranging from 1 to 100, but for this study, each decile has been collapsed into a single number. Included the occupational classifications (with representative occupations) were: 1) forestry workers and fisherman; 2) labourers and drivers;

3) semi-skilled tradesmen and factory workers; 4) skilled trademen and clerical workers; 5) teachers and middle managers; 6) senior managers and most professionals; and 7) judges and physicians. There were no occupations classified in group one. In addition, persons who were unemployed, and those women who were the heads of households and described their occupations as "housewife", were assigned a value of zero. There were strong differences across sites in the latter category: 21% of the Windsor sample and 36% of the Toronto sample were thus classified.

Etobicoke had the highest overall SES level, with larger numbers of parents working in skilled and professional capacities than other sites. The rural sites had more working-class occupations represented than other sites, but there was a representation of all socioeconomic categories across all sites. There were highly significant differences across sites in SES, and there were also differences between the urban, suburban and rural areas (Table K-9).

Houses Versus Apartments: Overall, almost three-quarters of the sample lived in houses. There were clear differences across sites, with more than 90% of families in Windsor and the two rural sites living in houses, and only 21% of Toronto families living in houses. Again, there were very strong differences across sites in the likelihood of living in a house, and there were also significant differences between sites in the urban and rural areas (Table K-10).

Age of Residence: Respondents in the two rural sites (Walpole and Longwoods) were more likely to report living in older houses than the other sites, although there was a substantial representation of older housing stock in Toronto as well. Etobicoke and Scarborough families reported newer (post-World War II) housing stock than other areas tested. Newer houses would be less likely to have used lead-based paint on interior walls. There were statistically significant differences across sites in the age of the residence, and urban and suburban areas also differed significantly between sites (Table K-11).

Use of Paint: Overall, 70% of houses were constructed of brick and, for those areas reporting use of other materials, the most common was aluminum siding. About one-quarter of houses were painted, while the majority of houses had painted trim. More than half of the owners reported that their houses had been painted within the last four years, and only 4% said that it had been ten years since the house was last painted. These figures suggest that flaking exterior paint may not represent significant risk factors for this sample. There were significant differences across sites in the use of paint (Tables K-12, K-13 and K-14).

Sources of Soil: Less than 4% of the overall sample reported that their houses had been built on landfill, while 37% noted that topsoil had been added at some time. Two-thirds of respondents noted that there were bare patches in their yards. For the almost 40% of residences with gardens, it may be that the topsoil had been added for that purpose. There were significant differences across sites on all three variables, and all three areas differed between sites on the likelihood of having a garden (Table K-15).

Heating: Nearly 65% of the sample used gas for heating, while 23% used oil. There were significant differences across sites in types of heating systems, as well as differences between sites in the rural, suburban and urban areas. For both fuels, forced air heat was the most common heating system. Less than a quarter of respondents had open fireplaces, and few families used them frequently. Again, these differences were significant across sites, and for rural and urban areas (Tables K-16, K-17 and K-18).

Renovations: More than one-third of families had done renovations on their houses, with plumbing work reported by 20% of families. If this work involved soldering of new pipes in the course of installing new bathrooms or kitchens, the risk of lead solder finding its way into the drinking water of these children may have been increased. There were differences across sites in the likelihood of doing renovations of each type (Table K-19).

Water Supply: Most families (80%) obtained their water supply from city sources, although a larger percentage of the sample of residents of Walpole and Longwoods drank well water or water from cisterns. There were significant differences between the two rural sites in the water supply source (Table K-20).

Lead Sources Near House: There were significant differences across sites in proximity to gas stations. Residents of Toronto and Scarborough reported more gas stations in their neighbourhoods and within one block of their houses than did residents in other sites. There were significant differences between sites for the rural, suburban and urban areas in proximity to gas stations within six blocks of the house, and for the suburban and urban sites for gas stations within one block of home (Tables K-21 and K-26).

Toronto inhabitants reported living nearer four-lane roads than did other site residents, and Scarborough and Etobicoke residents also reported living near larger roads. There were statistically significant differences across sites for both variables, and differences between the two sites in all three areas in proximity to four-lane roads (Tables K-22 and K-27).

There were significant differences across sites in proximity to minor highways, and differences between rural and suburban sites in the likelihood of living within six blocks of minor highways, but differences between sites only in the suburban area for minor highways within one block. Walpole and Longwoods residents reported living near more minor highways. However, these highways were relatively lightly travelled rural highways (Tables K-23 and K-28).

There were significant differences across sites, and within each area, in proximity to major highways. Almost 30% of Etobicoke residents lived within one block of a major highway (the 401), as did 25% of Longwoods residents (the 401) and Toronto families (the Gardiner Expressway). It should be noted that the 401 in Etobicoke is much more heavily travelled than it is in Longwoods (Table K-24 and K-29). Many of the Etobicoke residents also lived in the flight-path of Pearson International Airport.

There were significant site differences in proximity to major industries, although the only within-site difference was for the suburban sites in terms of number of industries within six blocks. The Toronto and Windsor residents reported living in the most industrialized area, while Etobicoke and the rural sites were least industrialized (Tables K-25 and K-30).

Road In Front of House: There were both differences across all sites, and between site differences within each area in the type of road on which the house was situated. Although a number of Walpole and Longwoods residents reported that their houses fronted on highways, as noted previously, these roads were lightly-travelled rural roads. Residents of Toronto and Scarborough were most apt to report living on major commercial streets with associated levels of heavy traffic (Table K-31).

Lifestyle Factors: Approximately one-fifth of households took part in hobbies or activities in the home which might have exposed their children to lead, including repairing cars, soldering, painting and refinishing furniture, although there were across-site differences for each of these hobbies. There were not strong between-site differences, although there were differences between rural and suburban sites in refinishing furniture, and between urban sites in soldering (Table K-32). Almost 40% of families cooked with vegetables from their own gardens, especially families in the rural sites. Approximately 30% of families ate such produce weekly during the summer. There were significant across-site differences for this factor, as well as differences between sites in each area (Table K-33).

There were differences across sites in the tendency to consume canned milk and to use electric kettles. Approximately 17% of families drank canned milk, but daily consumption was low (Table K-34). More than half of the families used electric kettles, but less than 16% of families said the kettles were more than five years old (Table K-35).

There were across-site differences for the number of pets owned, as well as urban and suburban between-site differences. Most of the families had dogs

or cats as pets, which may be major vehicles for outside dust. Rural families were particularly likely to have pets.

A significant percentage of families reported that their children chewed on non-food items on a regular basis. Pica has been associated with elevated blood lead levels in children, since chewing on items contaminated with lead in house dust or soil may lead to ingestion of significant quantities of lead. There were across-site differences in this risk factor, but between-site differences only for the rural area (Table K-37).

Types of Pipes: Most families agreed without reluctance to have their kitchen, bathroom and basement pipes inspected, although for the 30% of residents who lived in apartments, inspection of basement pipes was not possible. There were significant differences across sites for each of these variables (Tables K-38, K-40 and K-42).

Fewer than 1% of the sample reported that they had lead pipes in their homes, although about 12% reported that their pipes included lead with other materials. Usually, this reflected the presence of lead solder since interviewers had been instructed to code the presence of lead in an inclusive, rather than exclusive, fashion. There were highly significant differences across sites for each variable related to the presence of lead in pipes (Tables K-39, K-41 and K-43).

Child's Room: Although there were differences across sites in the extent to which parents allowed the child's room to be inspected, most parents were very cooperative (Table K-44). There were significant differences across sites in the floor covering of the child's room. Floor covering affects the amount of dust to which the child is potentially exposed (Table K-45). There were across-site differences in the extent to which there was peeling paint in the child's room, with Toronto and Longwoods having the highest percentages of peeling paint (Table K-46).

Child's Favourite Play Area: As well as the child's bedroom, the room in the house in which the child preferred to play was also inspected. There

were significant differences across sites in the flooring of the child's favourite play area (Table K-48), as well as the extent of peeling paint, again with Toronto and Longwoods reporting the highest percentages of peeling (Table K-49).

Condition of Exterior Paint: There were statistically significant differences across sites in the condition of exterior paint on the house, with Toronto and Longwoods reporting more peeling than other sites. Since less than 1% of Toronto houses, and only 10% of Longwoods houses are frame, while approximately 20% have aluminum siding, the figures indicating peeling paint for these two sites may refer more to peeling painted trim, which would be a less serious potential source of leaded paint than would peeling paint on housing stock constructed primarily of wood.

9.2 Analysis of Single Risk Factors in the Interviewed Sample

This chapter analyses the risk factors and their relationship to children's blood lead levels among the sample of 800 families interviewed.

The relationship between risk factors and blood lead was examined by simple regression analysis while controlling for the confounding effect of site. This was necessary because the sites differ significantly on many risk factors, as shown in the previous chapter. The effects to be discussed may be interpreted as occurring within each site. That is, variation of the risk factor within the same site is correlated with blood lead level.

A number of regressions were computed on blood lead for each potential risk factor separately, holding site constant. This enabled a preliminary evaluation of the individual contribution of each risk factor. Only those risk factors which had a significant association with blood lead at or above the 10% probability level are reported below. Single risk factor relationships are "artificial" in that they never exist in the absence of all simultaneous influences in the real world. Thus, interpretation of single risk factor associations should be approached with caution. These univariate analyses served as a basis to select specific factors for subsequent multiple regression models which simultaneously considered several risk factors together. Results of these regressions are presented in tabular form in Table 15.

Demographic Factors: The socioeconomic status of the household was significantly associated with blood lead levels; households in which the parent held a higher status job had children with lower blood lead levels. Children of parents who were manual or factory labourers who may have been expected to have increased occupational exposure to lead, were not significantly higher in blood lead levels when this coding of parental occupation was treated as a risk factor. The effect of socioeconomic status of the parents' occupations appeared to be an important risk factor

for reasons other than direct occupational exposure to lead. When occupations were further coded so as to reflect level of lead exposure typical for a given job, no significant effect was noted for that parental occupational exposure as a risk factor for children's blood lead levels.

There was a statistically significant effect for age represented by the categories less than four years, five years, and six years. Similarly, there was a statistically significant effect for sex, with boys having higher blood lead levels than girls.

Neighbourhood Factors: Several variables having to do with the location of family residence were significantly related to blood lead levels. These included the number of gas stations within six blocks of the house, with higher blood lead levels among children living near more gas stations.

The number of industries within six blocks of the house was statistically significant, as was the number of industries within one block. The relationship between the number of four-lane roads within six blocks of the house and blood lead was not significant, although the number within one block was significantly related to blood lead levels.

Although the number of minor highways within six blocks of the house was statistically significant, there was no significant relationship between the number of minor highways within one block and blood lead. The reverse was true of major highways: there was no statistically significant relationship for those who lived within six blocks, but blood lead levels increased for those reporting living within one block of a major highway. Higher traffic density was also associated with higher blood lead levels. Residential location near industries or heavily-trafficked roads was associated with higher blood lead levels.

House Versus Apartment: Some of the other significant risk factors were related to the likelihood of living in a house. Children of families living

in houses had significantly lower blood lead levels than children of families living in apartments. Some other variables which were significantly related to blood lead levels may be expected to be artifacts of living in a house.

For example, fireplaces might have been expected to add to lead exposure through burning of lead containing materials. However, children living in houses with fireplaces had lower blood lead levels than those who did not have fireplaces.

Similarly, if the family reported having a garden, blood lead levels tended to be lower. Other possible risk factors related to residence did not have significant effects on blood lead levels, including the type of construction or the age of the house, how long ago it had been painted, how much of it was painted, and whether it had undergone renovations, including renovations to pipes.

There were some housing factors significantly related to blood lead levels. Among these were the type of heating system, with hot water radiator systems (both oil and gas) being associated with higher blood lead levels than houses with forced air systems.

Age of the residence had no significant effect on children's blood lead level. There was a significant effect for residences with air filters; dwellings without filters were associated with higher blood lead levels.

Factors related to conditions in the child's room were also significantly associated to blood lead level. Children with the highest blood lead levels were more likely to live in rooms with linoleum, while intermediate blood lead levels were associated with rooms with bare hardwood or area rugs, and lowest levels were related to rooms with broadloom. The condition of the paint in the child's room was also significantly related to blood lead levels, with higher blood lead levels among children with rooms with peeling paint, and lower levels among children with rooms in which there was no

peeling paint. Similar findings were noted for condition of the paint in the child's favourite play area. Condition of exterior paint on the house was not related to blood lead levels.

Soil: Several other variables were associated with blood lead levels. Measures of soil lead (both with and without sandy soils) were significantly correlated. Children's tendency to chew on or eat non-food items (pica) was related to higher blood lead levels as was the presence of pets. Both of these latter variables suggest possible pathways for the ingestion of soil lead: furry pets may pick up outside dust or dirt contaminated with lead and, in turn, carry this dirt to the children who play with them. Children who put foreign objects in their mouths while playing outside may ingest more lead than children who do not. There was no significant association between pica and SES of parents.

The sites differed on numerous characteristics. In addition, many of the risk factors studied were highly intercorrelated. Both of these findings suggest that iterative modelling is required to pare down the number of variables used in building a meaningful model of risk factors for blood lead in children. This modelling process is discussed in the following section.

TABLE 15
RELATION BETWEEN RISK FACTORS* AND BLOOD LEAD
(HOLDING SITE CONSTANT)

<u>Demographic Factors</u>	<u>F</u>	<u>Degrees of Freedom</u>		<u>p</u>
		<u>Numerator</u>	<u>Denominator</u>	
Socioeconomic Status	4.65	6	774	.01
Age	4.27	3	1260	.001
Sex	5.26	1	1267	.001
<u>Neighbourhood Factors</u>				
Number of Gas Stations				
Within 6 Blocks	20.53	1	774	.001
Number of Minor Highways				
Within 6 Blocks	6.45	1	774	.05
Number of Industries				
Within 6 Blocks	6.45	1	774	.05
Number of 4-Lane Roads				
Within 1 Block	4.24	1	774	.05
Number of Major Highways				
Within 1 Block	11.42	1	774	.001
Number of Industries				
Within 1 Block	6.35	1	774	.05
<u>House Versus Apartment</u>				
Living in House	9.55	1	774	.01
Presence of Fireplace	9.92	1	774	.01
Presence of Garden	3.76	1	774	.10
<u>Housing Characteristics</u>				
Type of Heating	5.97	6	794	.01
Presence of Air Filter	5.07	1	774	.05
Flooring in Child's Room	3.39	4	785	.01
Condition of Paint in Child's Room	5.26	2	785	.01
Condition of Paint in Child's				
Favourite Play Area	5.83	2	790	.003
<u>Soil-Related Factors</u>				
All Samples	5.81	1	774	.05
Sandy Soils Excluded	5.48	1	774	.05
Presence of Pica	5.43	1	774	.05
Presence of Pets	5.06	1	774	.05

* Air not considered because only one measurement is representative of site air concentration.

CHAPTER 10.0 RESULTS OF MULTIPLE REGRESSION ANALYSIS

The analysis to this point examined relationships between single risk factors and children's blood lead levels. However, many variables studied are interrelated and co-exist. Consideration of multiple factors together in a regression model facilitates the interpretation of these factors which operate simultaneously.

Such a procedure permits the elimination of those risk factors which do not make a substantial contribution to children's blood lead concentrations. Since there was such a large number of factors potentially related to blood lead, the first step was to reduce the number of risk factors used as predictors by modelling.

10.1 Discussion of Statistical Analysis

Initially, all of the factors which were found to be statistically significant in the univariate analyses (controlled for site if appropriate), see Chapter IX, were included in a series of regression models, omitting air lead (which is confounded with site), soil lead measurements, and traffic density. These three risk factors were included in later regression models.

Intermediate Models: The first step in developing a workable model was to reduce the number of risk factors to be used. To do this, two regressions were computed: the first used risk factors related to the immediate home environment, and the second used risk factors related to the surrounding neighbourhood. Only those risk factors which single variable analysis had shown to be significantly associated with blood lead levels were included in each model. Site was included as a variable in each regression analysis, since there was substantial variability in risk factors across sites.

Socioeconomic status was also included in the model. House or apartment dwelling was not included as type of housing is associated with a number of other variables, such as garden or residential profile of the neighbourhood and socioeconomic status of the family. Thus, type of housing variables would not add to the meaningfulness of the model.

For a particular risk factor to be retained for subsequent analyses, probability values had to be below 5% ($p < .05$) for either the sequential F statistic or the F statistic for the simultaneous equation. The F statistic in a sequential analysis represents the unique contribution to explained variance of the specific risk factor over the factors entered previous to it; the F statistic in a simultaneous analysis represents the unique contribution of the specific risk factor in conjunction with all other risk factors in the equation.

Analysis of Home Environment Risk Factors

Table 16 presents the first regression for the risk factors relating to the home environment.

On the basis of failure to achieve statistical significance, home air filter, the floor covering in the child's room, presence of pets, the condition of paint in the child's room, and the condition of paint in the child's playroom were dropped from the analysis. The presence of a garden and fireplace were significant, but were dropped because of their strong association with living in a house and socioeconomic status. Retained were type of heating, whether or not the child chewed on non-food items, socioeconomic status and site.

Analysis of Neighbourhood Risk Factors

The second partial regression used those risk factors related to the characteristics of the surrounding neighbourhood, such as the number of gas stations and roads within six blocks or within one block of the residence.

Using the same criterion for statistical significance, the variables indicating the number of four-lane roads within one block and the number of industries within one block did not meet the criterion for statistical significance and were dropped from subsequent analyses (Table 17). Retained as predictors were the variables relating to the number of gas stations within six blocks, the number of industries within six blocks, the number of major highways within one block, site and socioeconomic status.

Comprehensive Model #1: Following the examination of the two preliminary regressions, a regression with all residential, demographic and neighbourhood variables previously demonstrated in the preliminary regressions to be significantly related to blood lead were entered as predictors. The risk factors entered included site, type of heating, age category of child, number of gas stations within six blocks, number of industries within six blocks, number of major highways within one block, whether or not the child chewed on non-food items (pica) and socioeconomic status (Table 18).

Results of this first attempt to examine the association of all of these risk factors with blood lead levels indicated that the strongest association with blood lead (aside from site) was socioeconomic status. Those children with parents in occupations associated with lower education and income levels had higher blood lead levels.

Several risk factors associated with residential proximity to traffic and industry were also significantly associated with blood lead, including the number of gas stations within six blocks, the number of industries within six blocks, and the number of major highways within one block. The two other risk factors significantly associated with blood lead were the child's age (with younger children having higher blood lead levels) and the type of heating in the house (with higher blood lead associated with houses with oil heat).

The only risk factor which was not a significant predictor of blood lead level in this model was pica. This variable was, therefore, dropped from the analysis, and the regression was repeated.

Comprehensive Model #2: In the second model, the regression was recalculated eliminating pica. It should be noted here that air lead and soil lead were not included in models 1 or 2 (Table 19).

A similar patterning of risk factors was evident in this second regression model as was apparent in the first regression. The percentage of variance accounted for by the model was 20%, as evaluated by r^2 . Knowledge of risk factors was useful in predicting blood lead levels, although 80% of the variability in blood lead levels could not be explained by this model.

Comprehensive Model #3: Air, Soil and Traffic Density as Surrogates for Site: The previous analyses were computed with site included but without air lead and soil lead values. The reason for the exclusion of air lead levels was that this risk factor was completely confounded with site. There was also little variability in soil lead levels, since there were only six average soil lead levels per site.

Soil lead level, traffic density and air lead levels were each positively correlated with blood lead. In order to see if soil lead levels, traffic density, and air lead levels together could replace site in accounting for variance in blood lead, the risk factors traffic density, (log) air lead and (log) soil lead (excluding sandy soils) were used as surrogates for site in the model (Table 20). The percent of variance accounted for by this model is 19%, and there are two fewer degrees of freedom in this model than in the previous one. Thus, we may consider the previous model and this one to be roughly equivalent in their ability to predict blood lead level. In other words, the information contained in the combination of the risk factors, air lead, soil lead, and traffic density appear to be almost as useful in

predicting blood lead values as site. These measures have the attraction of being more meaningful because they are measured values. Thus, this approach to the description of the relationships among the risk factors and blood lead levels appears useful.

It is noteworthy that the introduction of traffic density eliminated the statistical significance of the risk factor "living near major highways". In other words, once direct quantitative measurements of traffic density were available, a less direct qualitative measure, living near a major highway, lost its predictive power. Thus, traffic density for each site, in combination with measured air lead levels, neighbourhood industries, and soil lead levels, added to a constellation of factors associated with blood lead.

TABLE 16

INTERMEDIATE MODEL #1: REGRESSION OF HOME ENVIRONMENT
RISK FACTORS AND BLOOD LEAD CONCENTRATION

<u>Variables</u>	<u>df</u>	<u>Sequential F</u>	<u>p</u>	<u>Simultaneous F</u>	<u>p</u>
Site	5	25.60	.0001	12.49	.0001
Garden *	1	4.18	.0413	1.62	.2028
Fireplace *	1	9.75	.0019	4.31	.0383
Heating Type	6	3.93	.0007	2.48	.0221
Air Filter *	2	1.50	.2214	0.20	.2336
Child's Room Flooring *	4	2.05	.0862	1.16	.3262
Presence of Pets *	1	3.24	.0722	2.44	.1189
Condition of Paint in Child's Room *	2	1.95	.1426	0.61	.5423
Condition of Paint in Child's Playroom *	3	2.64	.0723	2.51	.0820
Child Chews on Non-Food Items	1	5.81	.0162	5.14	.0236
Socioeconomic Status	1	10.14	.0015	10.14	.0015

* Dropped from subsequent analyses.

TABLE 17

INTERMEDIATE MODEL #2: REGRESSION OF NEIGHBOURHOOD
RISK FACTORS AND BLOOD LEAD CONCENTRATION

<u>Variables</u>	<u>df</u>	<u>Sequential F</u>	<u>p</u>	<u>Simultaneous F</u>	<u>p</u>
Site	5	24.46	.0001	13.35	.0001
Gas Stations					
Within 6 Blocks	1	6.42	.0115	1.63	.2019
Industries Within					
6 Blocks	1	4.81	.0285	2.50	.1139
4-Lane Roads					
Within 1 Block *	1	3.39	.0662	0.97	.3259
Major Highways					
Within 1 Block	1	9.93	.0017	8.86	.0030
Industries Within					
1 Block *	1	1.82	.1782	1.88	.1705
Socioeconomic Status	6	4.28	.0003	4.28	.0003

* Dropped from subsequent analyses.

TABLE 18

COMPREHENSIVE MODEL #1: REGRESSION OF
RISK FACTORS AND BLOOD LEAD CONCENTRATION

<u>Variables</u>	<u>df</u>	<u>Sequential F</u>	<u>p</u>	<u>Simultaneous F</u>	<u>p</u>
Site	^a 5	25.85	.0001	15.46	.0001
Age Category of child	3	2.82	.0381	2.82	.0379
Sex*	1	2.47	.1161	2.87	.0909
Type of Heating	6	3.97	.0006	3.40	.0026
Gas Stations Within 6 Blocks	1	7.03	.0082	3.79	.0519
Industries Within 6 Blocks	1	4.18	.0412	3.79	.0519
Major Highways Within 1 Block	1	5.52	.0191	5.25	.0222
Pica*	1	3.59	.0584	2.99	.0840
Socioeconomic Status	1	16.17	.0001	16.17	.0001

* Dropped from subsequent analyses.

TABLE 19

COMPREHENSIVE MODEL #2: REGRESSION OF RISK FACTORS
(WITHOUT PICA OR SEX) AND BLOOD LEAD CONCENTRATION

<u>Variables</u>	<u>df</u>	<u>Sequential F</u>	<u>p</u>	<u>Simultaneous F</u>	<u>p</u>
Site	5	25.69	.0001	16.24	.0001
Type of Heating	6	3.90	.0008	3.33	.0031
Age Category of child	3	2.81	.0388	2.93	.0330
Gas Stations Within 6 Blocks	1	7.23	.0073	4.05	.0444
Industries Within 6 Blocks	1	4.55	.0333	4.37	.0368
Major Highways Within 1 Block	1	5.23	.0225	4.85	.0280
Socioeconomic Status	1	16.44	.0001	16.44	.0001

TABLE 20

COMPREHENSIVE MODEL #3: REGRESSION OF RISK FACTORS
(INCLUDING AIR, SOIL, AND TRAFFIC MEASURES)
AND BLOOD LEAD CONCENTRATION

<u>Variables</u>	<u>df</u>	<u>Sequential F</u>	<u>p</u>	<u>Simultaneous F</u>	<u>p</u>
Log of Air Lead	1	73.70	.0001	15.14	.0001
Log of Soil Lead (sandy soil omitted)	1	23.77	.0001	8.04	.0047
Age Category	3	2.33	.0729	2.29	.0771
Heating Type	6	2.99	.0068	2.52	.0204
Gas Stations Within 6 Blocks	1	6.56	.0107	2.72	.0998
Industries Within 6 Blocks	1	2.82	.0938	4.97	.0260
Major Highways Within 1 Block	1	.73	.3941	1.80	.1801
Traffic Density	1	12.17	.0005	16.30	.0001
Socioeconomic Status	1	26.67	.0001	26.67	.0001

TABLE 21

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Risk Factors Considered in the Interviewed
Sample of 800 Families and their
Relationship to Children's Blood Lead Levels

Socio-demographic Factors

- x * Age of child
- * Sex of child
- Number of adults living at home
- Number of children living at home
- Use of a family doctor
- x * Father's current occupation
- Father's previous occupation
- Father's part-time occupation
- x * Mother's current occupation
- Whether mother is or has been a leadworker
- Mother's previous occupation
- Mother's part-time occupation
- Current occupation of other adults living with child
- Whether other adults are or have been leadworkers
- Part time occupation of other adults

Residential/Housing Factors

(For each of up to three residences lived in for longest periods of time during a child's lifetime)

Age of house
Length of residence (in years)
Type of construction (brick, wood, stone, aluminium, stucco, insulbrick, other)
Painted exterior
When exterior last painted

- *= Significantly associated with blood lead level ($p < .10$) in univariate analyses
- x= Significantly associated with blood lead level ($p < .05$) in multivariate analyses (all * factors considered simultaneously).

- Residence built on landfill
- Top soil added to yard
- Unsodded bare patches of soil in yard
- Presence of vegetable garden
- Child's usual outdoor play area (own yard, friend's yard, street, park, other)
- Percentage of bare ground in child's favourite play area
- x * Type of heating (oil-forced air, oil-hot water, gas-force air, gas-hot water, hydro, wood stove, hot water-radiator)
- * Presence of fireplace
- Frequency of fireplace use
- Burning of newspapers with coloured inks in fireplace
- Presence of forced air heating
- * Presence of air filter
- Presence of air cleaner
- Presence of air conditioner
- Major renovations during child's lifetime
- Source of water supply
- * House or apartment

The following were determined by physical inspection:

- Type of pipes in kitchen (galvanized iron, copper, lead, plastic, combination with lead, combination without lead)
- Type of pipes in bathroom (galvanized iron, copper, lead, plastic, combination with lead, combination without lead)
- Type of pipes in basement (galvanized iron, copper, lead, plastic, combination with lead, combination without lead)
- * Type of flooring in child's room (broadloom, bare hardwood, area rugs, linoleum, other)
- * Condition of paint in child's room (peeling, some peeling no peeling)
- * Type of flooring in child's favourite play area
- Condition of paint in child's favourite play area
- Condition of exterior paint

- *= Significantly associated with blood lead level ($p < .10$) in univariate analyses
- x= Significantly associated with blood lead level ($p < .05$) in multivariate analyses (all * factors considered simultaneously).

Neighbourhood Factors

- x Number of gas stations within 6 blocks of residence
- Number of 4 lane roads within 6 blocks
- Number of minor highways within 6 blocks
- Number of major highways within 6 blocks
- x * Number of major industries within 6 blocks
- Number of gas stations within 1 block
- Number of 4 lane roads within 1 block
- Number of minor highways within 1 block
- x * Number of major highways within 1 block
- Number of major industries within 1 block
- Kind of road in front of house

Lifestyle Factors

- Family hobbies (soldering, painting, stained glass making,
pottery glazing, auto repair, furniture refinishing)
- Use of own home grown vegetables
- Frequency of use of own home-grown vegetables
- Use of canned milk
- Frequency of use of canned milk
- Use of electric kettle
- Age of electric kettle
- Use of medication by child
- * Presence of pets
- * Tendency to eat or chew non-food items (pica)

- *= Significantly associated with blood lead level ($p < .10$) in
 univariate analyses
- x= Significantly associated with blood lead level ($p < .05$) in
 multivariate analyses (all * factors considered
 simultaneously).

CHAPTER 11.0 DISCUSSION OF RESULTS

This chapter discusses the major findings of this study.

11.1 Mean Blood Lead Levels

The overall average blood lead level (geometric mean) for the 1269 children aged six and under in this study was 0.50 $\mu\text{mol/L}$ (10.36 $\mu\text{g/dl}$). This level is lower than that reported by the most recent published National Health and Nutrition Examination Survey (NHANES) of American children (1976-1980)⁵, which reported geometric mean blood lead concentrations ranging from 13.8 to 14.3 $\mu\text{g/dl}$ for their sample of six-month to five-year-old white children, and geometric means ranging from 18.2 to 21.3 $\mu\text{g/dl}$ for black children of similar ages.

The NHANES study was a very large national probability sample which did not exclude persons living near known point sources of lead and included a greater proportion of urban dwellers than the present Ontario sample. Urban dwellers have previously been shown to have higher blood lead levels than individuals who live in suburban and rural areas. This finding was confirmed by the present study.

The higher blood lead levels reported for the U.S. children might also be a function of the time period during which that research was carried out. The NHANES researchers commented that blood lead concentrations had declined by 37% on the average, from 1976 to 1980, noting that this period had followed the imposition of controls on the concentration of lead in gasoline. The Ontario data collection period occurred four years later. If the trend towards lower average blood lead levels in the U.S. has continued at the same rate, it might be expected that U.S. and Canadian children now may have similar levels of blood lead.

Compared to children in the NHANES study, a smaller proportion of children in the Ontario study had blood lead levels higher than 1.45 $\mu\text{mol/L}$ (30 $\mu\text{g/dl}$), 0.6% compared to 4%. This finding is consistent with the

lower mean values for blood lead in the Ontario sample and with the distribution of scores shifted towards the lower end of the scale. An additional 0.8% of children in the Ontario sample were between 1.21 $\mu\text{mol/L}$ (25 $\mu\text{g/dl}$) and 1.45 $\mu\text{mol/L}$ (30 $\mu\text{g/dl}$). Thus, by currently accepted standards for assessing the immediate health risks of blood lead concentrations (25 $\mu\text{g/dl}$), only 1.4% of the children aged six and under could be judged at risk by blood lead determination at the end of summer, the period of potential peak exposure from the outside environment.

There were higher blood lead concentrations among boys than among girls in this sample. The same observation has been reported elsewhere.⁵ Younger children had higher blood lead concentrations than older children in the Ontario sample. A similar age trend has been reported in other studies.^{5,13}

11.2 Air Lead

Sites for the study were selected to represent typical urban, suburban and rural air lead values. The sites were chosen from those areas which had Ontario Ministry of the Environment air samplers and had no known point sources of lead emissions.

There were significant differences in air lead among the urban, suburban and rural sites. The urban sites had higher levels than the other sites. Air lead values for all six sites were at the low end of expected values for urban, suburban, and rural sites respectively. There was a significant association between air lead and blood lead levels, although the correlation (0.25) was relatively low. Air lead measurements came from a single sampling location in each site and may not necessarily completely represent air lead levels in the child's home or school environment.

Because of the small number of schools available for testing in the rural Nanticoke-Walpole area, it was necessary to request the participation of schools that were much farther apart from the air samplers and from each other than in the other sites.

In addition to the air lead data, measurements of traffic density at each site were obtained from the Ontario Ministry of Transportation and Communications. There were not strong differences in traffic density among the urban and suburban sites but traffic was lighter in both rural sites.

11.3 Water Lead

Overall, there were generally very low levels of lead detected in the school water samples tested. It does not appear that municipal water supplies contributed substantially to the blood lead levels of these children. However, water was not tested from individual residences so that it is not possible to draw conclusions about the possible contribution of lead from residential pipes and fittings for this sample.

11.4 Soil Lead

Soil lead was assessed from schoolyard samples collected by the Ministry of the Environment. There were significant differences across sites in soil lead levels. Once data from two schools in Dunnville (rural Nanticoke-Walpole) with atypically high values were excluded, urban sites had highest soil lead levels, followed by suburban sites and rural sites. The higher soil lead levels for the schools sampled in Dunnville represent an unexpected finding.

The average soil lead levels for Dunnville were considerably higher than for the other four Nanticoke-Walpole schools; this suggests that Dunnville may be significantly different on some other lead-related factors. Traffic density for Dunnville was in the same low volume range as for the other locations within the Nanticoke-Walpole site, suggesting that the difference noted in Dunnville may be attributable to a local source other than automobile traffic.

There was a small but significant correlation (0.28) between children's blood lead levels and soil lead, indicating that increased blood lead was associated with higher soil lead values. It is noteworthy that average blood lead levels in Nanticoke-Walpole were higher than in the other rural site (Longwoods) and resembled suburban levels. Because soil samples were collected for each school within each site, it was possible to identify schools with atypical values. This was not possible for air lead values, since there was only one air lead sampler for each site.

There was a moderately strong correlation (0.44) between soil lead and air lead levels, consistent with previous studies documenting the association between the two environmental lead measures.¹⁶

11.5 Demographic Factors

Blood lead levels were lower among children from higher SES families in which parents held jobs which were higher paying and/or required more education. This finding is similar to that of other studies.^{1,3,5}

The higher blood lead levels of children from lower SES families could be attributed to occupational exposure to lead among parents. When parental occupation such as manual or factory work was treated as a risk factor, no significant relationship to blood lead was found. When parental occupation was recoded in terms of potential exposure to lead and treated as a risk factor, again, there was no significant relationship to children's blood lead levels. This is not to say that this finding presents evidence that occupational lead exposure is not a source of lead contamination for some children. Less than 4% of the sample reported working with lead or being tested for lead on the job. A sample of this size was too small to be able to detect a small increase in children's blood lead levels associated with parental occupation.

When reported occupations were recoded to reflect hypothesized degrees of occupational exposure to lead, less than 18% of the sample was classified as potentially exposed. This too, may have been an insufficient number to reflect differences in blood lead because some of the occupations classified as entailing some lead exposure may, in fact, provide minimal contact with lead.

11.6 Neighbourhood Factors

A number of risk factors associated with neighbourhood characteristics were associated with children's blood lead levels. The number of industries in the immediate (one block) and near (six blocks) neighbourhood was associated with children's blood lead levels, as were the number and size of major roads and highways. Living within one block of a major highway and the number of gas stations within six blocks were strongly associated with higher blood lead levels.

Blood lead levels were associated with the number of gas stations within six blocks, but not with the number of gas stations within one block. The number of families reporting residence within one block of a gas station was too small to allow statistical significance, however.

11.7 Housing Factors

Several risk factors associated with housing were associated with blood lead levels. Most of these factors appeared to parallel the socioeconomic relationships previously described. Children who lived in houses had lower blood lead levels than children who lived in apartments. Presence of a fireplace in the home and garden were associated with lower blood lead levels. It may be assumed that families who live in houses have higher incomes than families who live in apartments. Many factors related to the family residence were found to be unrelated to blood lead, including the age of the house, condition of the exterior paint, when it had been painted or

whether it had undergone renovations. The lack of effect produced by these measures and the fact that children who live in houses with fireplaces and gardens tended to have lower blood lead levels, may reflect the fact that houses in general, and more expensive houses in particular, may be located in neighbourhoods which are comparatively free of gas stations, industries or heavily-travelled roads, those risk factors which appeared to be most strongly associated with blood lead in subsequent analyses.

The condition of paint in the child's room and favourite play area was found to be associated with blood lead, however. There may be differences in sources of lead related to housing between U.S. and Canadian children. Painted wood houses are considerably less common in Ontario than in many parts of the United States; only 7% of the present sample lived in wood houses versus more than 50% of the U.S. sample in the NHANES study. Exterior paint appeared to be a non-significant source of lead paint chips for Ontario children. However, paint from peeling surfaces in interior rooms, a significantly related factor, may remain a potential risk factor for children where housing conditions are such that peeling interior paint is likely. Given the fact that the age of the residence was not related to blood lead level (many of the rural houses were built before World War II), the state of dilapidation of the older dwellings may better reflect the potential risk to children.

11.8 Simultaneous Analysis of Risk Factors

The modelling of the data by a series of regression equations which included consideration of all the identified risk factors together, resulted in the identification of significant associations between blood lead levels and demographic and environmental factors. These factors were: age of child, air and soil lead, type of heating, number of gas stations and industries within six blocks, major highways within one block of the home, traffic density and socioeconomic status of the household as measured by parental occupation.

Geographic "site" was associated with children's blood lead levels. When air lead, soil lead and traffic density were used as surrogate measures for site, the relationship with blood lead was retained. These three environmental measures of lead were associated more strongly with blood lead than all other risk factors except SES. It is noteworthy that the indirect measures of air lead - gas stations and major industries in the neighbourhood - were also significantly associated with blood lead concentrations in children. It was possible to determine the contribution of air-borne lead made by automobiles fuelled by leaded gasoline. Measurements of lead and bromine levels in air in all sites but one (Scarborough), allowed the proportion of lead in air attributable to motor vehicle exhaust to be calculated. Proportions varied by site with higher proportions in more heavily urbanized areas: 67+ 5% in Nanticoke-Walpole; 77+ 5% in Longwoods; 73+ 5% in Etobicoke; 85+ 5% in Toronto; 80+ 5% in Windsor. Once traffic density in an area was included in the analytic model, living near a major highway did not maintain statistical significance. The significance of these environmental risk factors in explaining higher blood lead levels suggests the role played by air-borne lead in increased blood lead levels among children.

SES was very strongly associated with blood lead levels in the regression models which took into account simultaneously all of the other significant risk factors. Socioeconomic status was associated, as well, with numerous risk factors which may not have been significant enough alone to account for increases in blood lead levels. For instance, there was a significant association between living in an apartment and increased blood lead levels in the univariate analysis. Similarly, the small numbers of lead worker parents identified were employed in semi-skilled or skilled jobs; characterizing lower socioeconomic status for the family. No white-collar workers were identified as having occupational contact with lead.

As suggested elsewhere, specific mechanisms such as pica, exist through which the children of parents with low socioeconomic status may have

increased exposure to lead,⁵ although the relationship of socioeconomic status to pica was not significant in this study. Many children in the Toronto and Windsor sites lived in single-parent households, and both sites had high levels of unemployment. Children whose parents are on welfare are living below the poverty line as defined by Statistics Canada. If they have inadequate diets, these diets may fail to buffer them from the effects of environmental lead. Recent research has underlined the role that anemia may play.²⁴ Children with anemia demonstrate higher blood lead levels with lead binding the hemoglobin at a higher-than-normal rate. Early literature suggests that malnutrition in low socioeconomic status families was a contributing cause of lead poisoning.

Some animal studies demonstrated that increased dietary fat and decreased calcium, iron, and possibly other nutrients enhance the absorption of lead. This has never been demonstrated in children. It is difficult to separate possible nutritional influences from other SES-associated variables. Thus, socioeconomic status, in its significant relationship to higher blood lead levels in children, probably served as a crude surrogate measure for more refined and specific indicators which were unmeasured in this study.

This study did not examine dietary intake of lead which, in Canada, may account for up to 65% of daily lead intake. Nonetheless, this study does demonstrate that factors relating to air lead, soil lead, traffic density, age and SES account for 20% of the variability in children's blood lead levels in Ontario. Taking into account variations of dietary intake of lead would be expected to have increased the ability to account for the differences in blood lead shown.

**BLOOD LEAD AND
ASSOCIATED RISK FACTORS
IN ONTARIO CHILDREN, 1984:**

APPENDICES

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DESCRIPTIONS OF AIR SAMPLERS AND MAPS OF SITES

DESCRIPTION OF AIR SAMPLERS

At each site, high volume samplers were in place, and dichotomous samplers were also in use during the study in the Windsor, Toronto, Etobicoke and Longwoods sites. When initial blood lead results became available in January, an additional dichotomous sampler was transported to the Walpole site, where data was collected for three weeks. The location and elevation of the samplers were as follows:

<u>Site</u>	<u>Elevation</u> (meters)	<u>Location</u>
1. Windsor	4	College and South Streets
2. Scarborough	1	Redland Crescent (Scarborough Bluffs)
3. Etobicoke	1	Elmcrest and Rathburn Roads
4. Walpole	4	Sandusk Road, near Walpole
5. Longwoods	1	Longwoods Conservation Authority
6. Toronto	5	Sherbourne and Wilton Streets

High volume samplers draw air into a louvered housing and through a glass fibre filter by means of a high flow rate blower at a rate of approximately 1.1 to 1.7 m³/min (40 to 60 ft³/min) to sample suspended particles in the size range 0.1 to 100 μ m in diameter. The mass concentration of total suspended particulate matter (TSP) in the ambient air sampled, in ug/m³, is computed from the mass of collected particles and the volume of air sampled.

The particle collection efficiency of the high volume sampler varies with wind direction and wind speed. However, this only occurs for particles greater than 5 μ m in aerodynamic diameter. Airborne lead is primarily found in small particles (less than 2.5 μ m in aerodynamic diameter). For this particle size, the high volume sampler has a collection efficiency greater than 99%. Heavy particulate loadings, moisture and filter-reactive gases may tend to clog the filter and lower the flow rate of the sampler.

Therefore, all samplers used in this study were fitted with flow controllers to maintain optimum collection efficiency.

High volume samplers are routinely employed to measure airborne particulate. However, dichotomous samplers have recently been used to collect particulates of the inhalable size range (generally, this size range is considered to be less than 10 μm in aerodynamic diameter). These samplers fractionate particles into coarse (2.5 - 10 μm aerodynamic diameter) and fine (less than 2.5 μm aerodynamic diameter) size fractions. Generally the fine fraction is made up of smoke-type particles and is the size range in which most airborne lead is found. Particles of this size range which are inhaled, deposit with greatest frequency deep in the lung.

College/South St.

100 PI

102 PI

SCALE 1:75,000 ÉCHELLE

Windsor, Ontario, Canada

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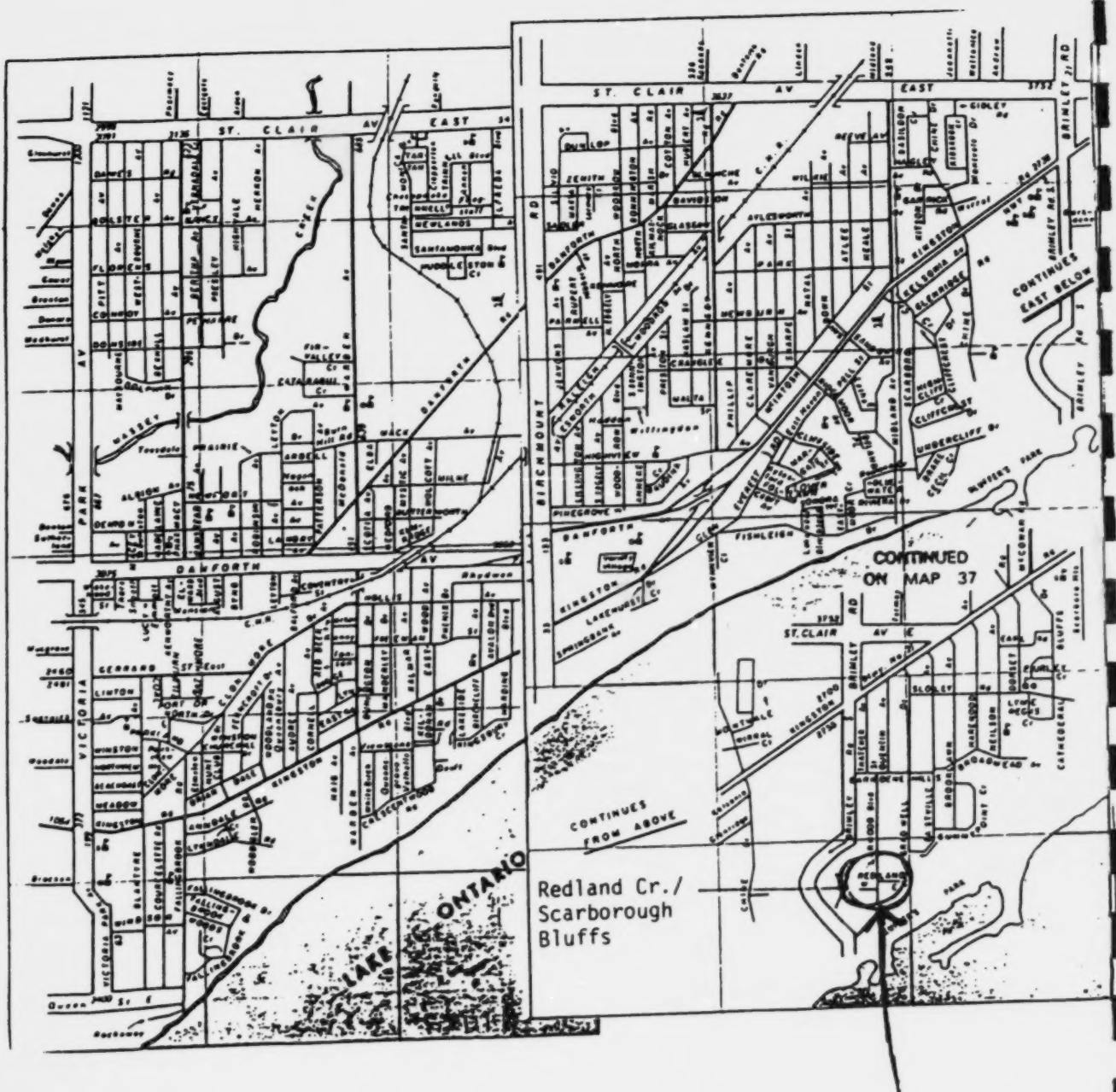
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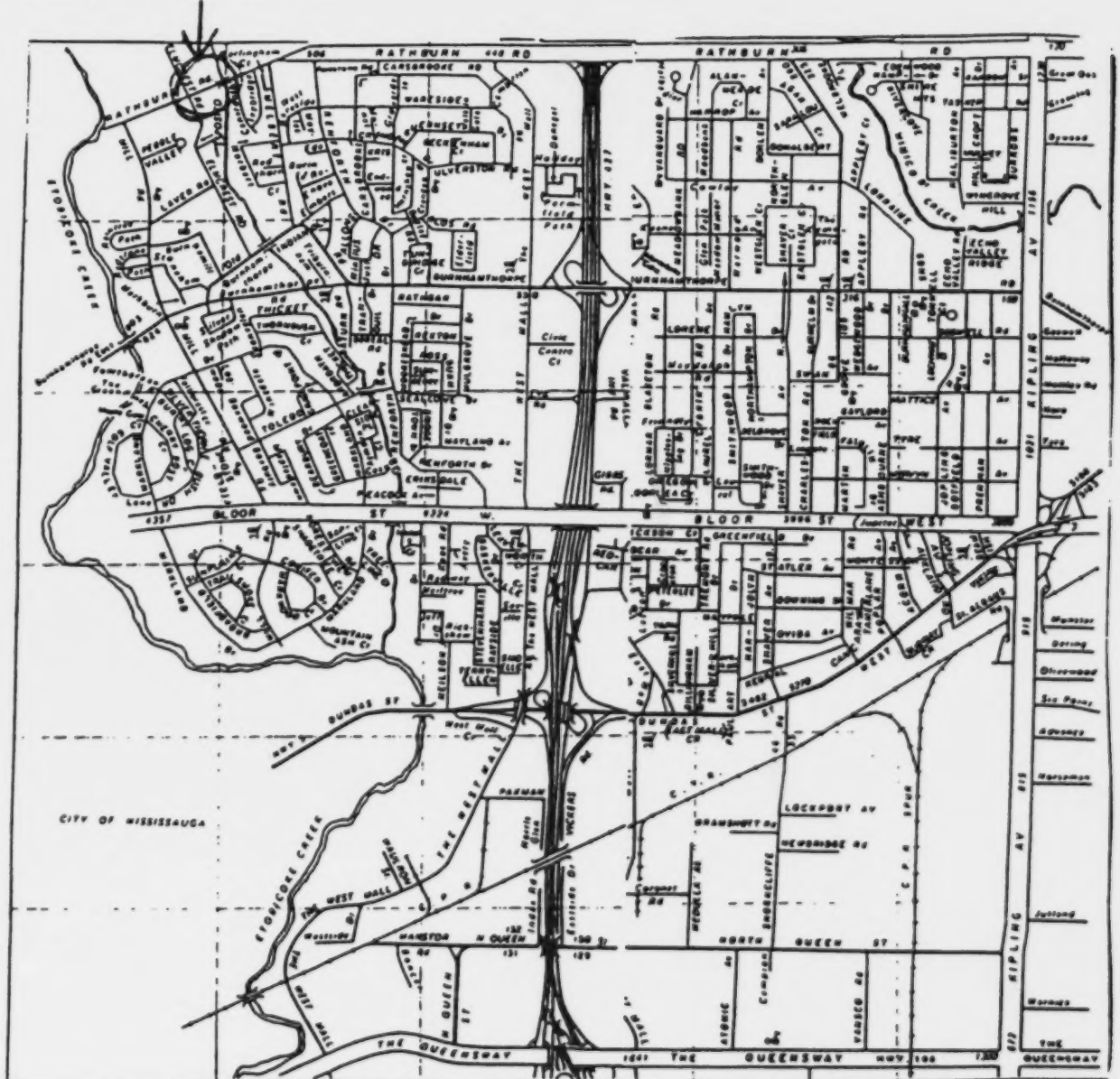
College/South St.

SCARBOROUGH

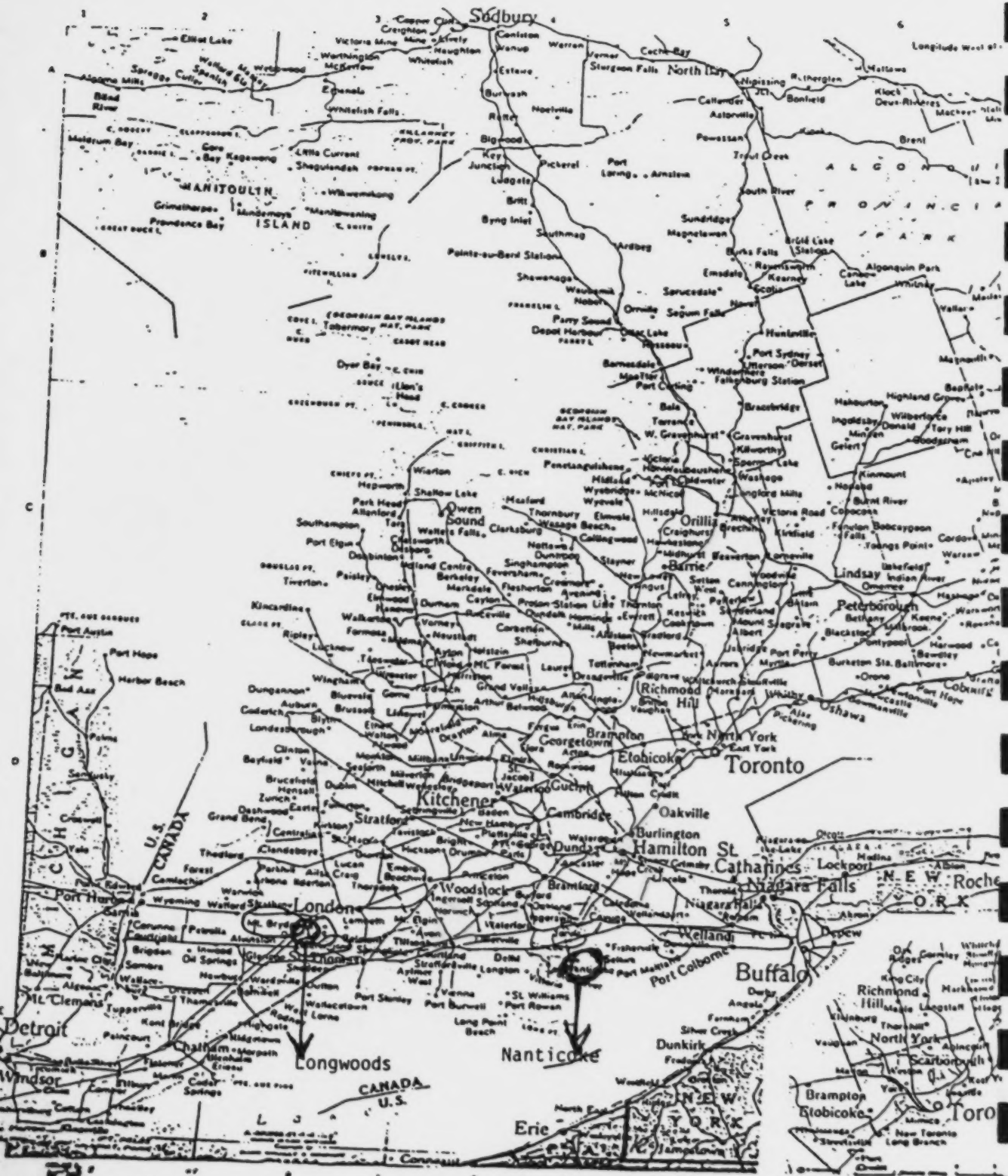


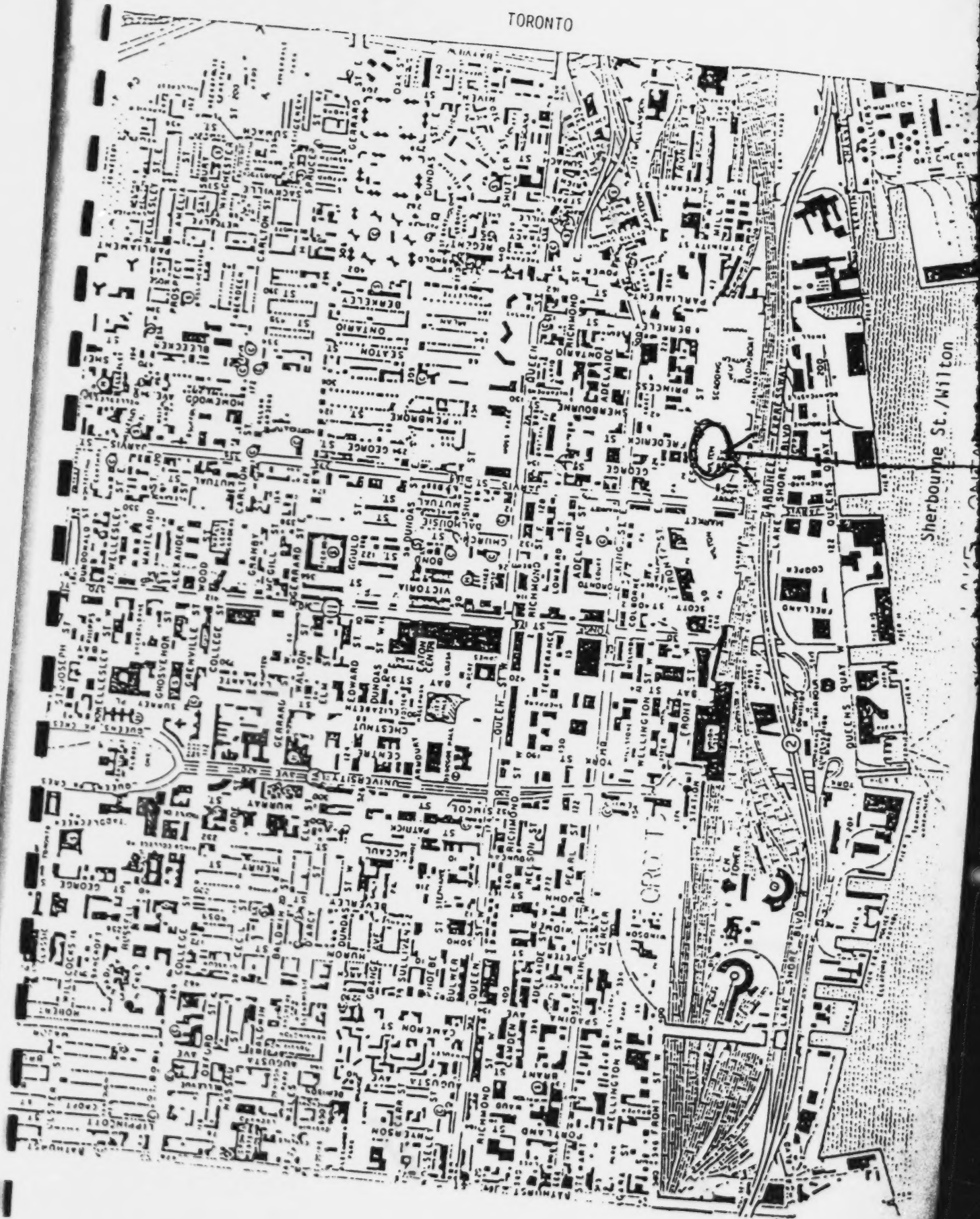
ETOBICOKE

Elmcrest Rd./Rathburn Rd.



LONGWOODS & WALPOLE





LIST OF SCHOOLS

BLOOD LEAD STUDY

SCHOOLS

(33019)

SCARBOROUGH

Site: Redland Crescent (Scarborough Bluffs)

Board

Public

- Scarborough Board of Education
Civic Centre
140 Borough Drive
Scarborough, Ontario
M1P 4N6
Chairman: M.P. Collie
Director of Education:
J.P. McLoughlin, B.A., B.Ed.
Telephone (416) 296-7111

Separate

- Metro Toronto Separate
School Board
80 Sheppard Avenue East
Willowdale, Ontario
M2N 6E8
Chairman: P.J. Duggan
Director of Education: B.J. Kipp
Telephone 222-8282

SCHOOLS

- o Fairmount Junior School
31 Sloley Road
Scarborough M1M 1C7
Principal: Mr. Addison
Telephone (416) 261-6144
(JK-6) (207 pupils)
- o Chine Drive Elementary School
51 Chine Drive
Scarborough M1M 2K8
Principal: Mr. J.W. Henry
Telephone: (416) 261-7284
(JK-8) (115 pupils)
- o John A. Leslie
459 Midland Avenue
Scarborough, M1N 4A7
Principal: T.Z. Power, B.A.
Telephone: 261-6128
(JK-8) (431 pupils)
- o Cliffside Junior School
27 East Haven Drive
Scarborough, M1N 1M1
Principal: D.R. MacDonald, B.A., B. Ed.
Telephone: 261-6155
(JK-6) (199 pupils)
- o Birch Cliff
1650 Kingston Road
Scarborough, M1N 1S2
Principal: E.V. Hughes, B.A., M.Ed.
Telephone: 691-7907
(JK-8) (490 pupils)

(15009)
LONGWOODS (London)

Boards

Public

- Middlesex County Board of Education
Hyde Park, Hwy. 22 & Hyde Park Road
London, Ontario
NOM 120
Chairman: C.P. Lynn
Director of Education:
F.S. Toll, B.A., M.Ed.
Telephone (519) 471-3510

Separate

- London & Middlesex
RC Separate School Bd.
Box 517
London, Ontario
N6A 4X5
410 Queens Ave.
Chairman:
Mrs. M.E. Joyce
Director of Education:
K.J. Regan
Telephone
(519) 432-3493

SCHOOLS

- o Delaware Elementary School
Box 36
Country Road 3
Delaware, Ontario
NOL 1EO
Principal: B.L.C. Kells, B.A., B.Ed.
Telephone (519) 652-5371
(K-8) 203 pupils
- o Caradoc Central
Box 244
61 Bowen Street East
Mount Bridges, Ontario
NOL 1NO
Principal: Mr. Leatham
Telephone: (519) 264-1630
(K-8) 287 pupils
- o Parkview Elementary
133 Concession Avenue
Komoka, Ontario
Principal: F. Berdan
Telephone: (519) 471-0397
(K-8) 345 pupils
- o Caradoc South
40 Peter Street
Melbourne, Ontario
NOL 1TO
Principal: G.A. Adlington, B.A., M. Ed.
Telephone: (519) 289-2091
(K-8) 169 pupils

- o Our Lady of Lourdes
Delaware, Ontario
NOL 1EO
Principal:
Mr. Tom Clark
Telephone:
(519) 652-5631
(JK-8) 274 pupils

- A.E. Duffield
o Box 460
Willow Street
Lambeth, Ontario
NOL 1SO
Principal:
J.F. Rowe, B.A.
(519) 652-2050
(I-8) 133 pupils

TORONTO

Boards

Public

- Toronto Board of Education
155 College Street
Toronto, Ontario
M5T 1P6
Chairman: P. Moss
Director of Education:
Dr. E.N. McKeown, B.A., M.Ed.
Telephone (416) 598-4931

Separate

- Metro Toronto Separate
School Board
80 Sheppard Avenue East
Willowdale, Ontario
M2N 6E8
Chairman: P.J. Duggan
Director of Education:
B.J. Kipp, B.A., M.Ed.
Telephone (416) 222-8282

SCHOOLS

- o Park Junior School
440 Shuter Street
Toronto, Ontario
M5A 1X6
Principal: Walter Sinclair
Telephone: (416) 364-8717
(JK-8) 501 pupils
- o Regent Park Junior School
20 Regent Street
Toronto, Ontario
M5N 3N6
Principal: R.M. McCordie, B.A., M.Ed.
Telephone: (416) 363-3441
(JK-6) 268 pupils
- o Church Street Junior School
83 Alexander Street
Toronto, Ontario
M4Y 1B7
Principal: Mrs. Strynatka
Telephone: (416) 922-5990
(JK-6,8) 174 pupils
- o St. Michael on the Lane
50 George Street
Toronto, Ontario
M5A 4B2
Principal:
Sister L. Pickett, B.A.
Telephone:
(416) 366-1535
(JK-8) 157 pupils
- o St. Paul
80 Sackville Street
Toronto, Ontario
M5A 3E5
Principal:
J. Blonde, B.A., M.Ed.
Telephone: 368-2667
(JK-8) 232 pupils

WINDSOR

Boards

Public

- Windsor Board of Education
Box 210, Windsor,
Ontario, N9A 6K1
451 Park St. W.
Chairman: F. Alexander
Director of Education: W.P. Willms
Telephone (519) 255-3200

Separate

- Windsor RC Separate
School Board
1485 Janette Avenue
Windsor, Ontario
N8X 1Z2
Chairman: M.J. Brogan
Director of Education:
W.M. McRae, B.A., M.Ed.
Telephone (519) 253-2481

SCHOOLS

- o Marlborough Public School
3557 Melbourne Road
Windsor, Ontario
N9C 1Y6
Principal:
Mrs. S. Taylor, B.A., M.Ed.
Telephone (519) 254-2881
(K-8) 475 pupils
- o General Brock
3312 Sandwich Street
Windsor, Ontario
N9C 1B1
Principal: J. Muir, B.A., M. Ed.
Telephone: (519) 254-2571
(JK-8) 282 pupils
- o Dr. H.D. Taylor
1275 Campbell Avenue
Windsor, Ontario
N9B 3M7
Principal: L. Wintonyk, B.A.
Telephone: (519) 252-7729
(K-8) 378 pupils
- o St. James
1601 St. James Street
Windsor, Ontario
N9C 3P6
Principal: R. Murphy
Telephone (519) 252-9960
(K-8) 322 pupils
- o St. Francis
477 Detroit Street
Windsor, Ontario
N9C 2P6
Principal:
R.Lacoursiere, B.A., M.Ed.
Telephone (519) 253-8327
(K-8) 253 pupils
- o St. Edward
3735 King Street
Windsor, Ontario
N9C 1P7
Principal:
R. Goyeau, B.A., M. Ed.
Telephone (519) 254-9488
(K-8) 250 pupils

ETOBICOKE

Site: Elmcrest Road & Rathburn Street

Board

Public

- Etobicoke Board of Education
1 Civic Centre Court
Etobicoke, Ontario
M9C 2B3
Chairman: W.H. Williams
Director of Education:
S.S. Sauro, B.A., M.Ed.
Telephone (416) 626-4360

Separate

- Metro Toronto Separate
School Board
80 Sheppard Ave. East
Willowdale, Ontario
M2N 6E8
Chairman: P.J. Duggan
Director of Education:
B.J. Kipp, B.A., M.Ed.
Telephone (416) 222-8282

SCHOOLS

- o Mill Valley Junior School
411 Mill Road
Etobicoke, Ontario M9C 1Y9
Principal:
Wayne Dickson
Telephone (416) 621-7319
(JK-5) 136 pupils
- o Broadacres Junior School
45 Crendon Drive
Etobicoke, Ontario M9C 3G6
Principal: G. Skinner, B.A., M.Ed.
Telephone (416) 621-2711
(JK-5) 361 pupils
- o Wellesworth Junior School
225 Wellesworth Drive
Etobicoke, Ontario M9C 4S5
Principal: C.E. Kjertinge, B.A., M.Ed.
Telephone (416) 621-5443
(JK-5) 275 pupils
- o Millwood Junior School
222 Mill Road
Etobicoke, Ontario M9C 1Y2
Principal: David Barr
Telephone (416) 621-8301
(JK-5) 504 pupils

WALPOLE

Board

Public

- Haldimand Board of Education
Box 2000
Munsee Street
Cayuga, Ontario
NOA 1EO
Chairman: J.C. Lang
Director of Education: J. Fransen
Telephone (416) 772-3391

Separate

- Haldimand Norfolk RC
Separate School Board
Box 278, Regional Road 40
Simcoe, Ontario N3Y 4L1
Chairman: A. Bukta
Director of Education:
A.J. Homeniuk
Telephone (519) 426-8370

SCHOOLS

- o Walpole North
R.R. 5, Springvale Road
Hagersville, Ontario
NOA 1HO
Principal: O. McCreight, B.A., Ms.Ed.
Telephone (416) 768-5112
(K-8) 214 pupils
- o Walpole South
R.R.2, Sandusk Road
Nanticoke, Ontario
NOA 1LO
Principal: L. Merritt, B.A., BPE, ME
Telephone (519) 587-2591
(K-7) 194 pupils
- o Jarvis
Monson Street
Jarvis, Ontario
NOA 1JO
Principal: E. Burnside, B.A., M.Sc.Ed.
Telephone (519) 587-2612
(K-8) 171 pupils
- o Dunnville Central
121 Alder St. W.
Dunnville, Ontario
N1A 1R2
Principal: R. Richardson, B.A., B.Ed.
Telephone (416) 774-6033
(K-6) 258 pupils

- o St. Cecilia's
R.R. #2
3 Lyn Park
Port Dover, Ontario
NOA 1NO
Principal:
A.M. Dekeukelaere,
B.A., M. Ed.
Telephone (519) 583-0231
(K-8) 125 pupils
- o St. Michael's
209 Alder St. W.
Dunnville, Ontario
N1A 1R3
Principal:
A.A. Kuzmickas, B.A.
Telephone (416) 774-6052
(K-8) 150 pupils

**COPIES OF LETTERS TO
DIRECTORS OF EDUCATION, PRINCIPALS AND
PARENTS AND PARENT CONSENT FORMS**

Draft Letter from School Boards to Principals

Dear Principal,

I am writing to send you information on the blood lead testing program sponsored by the Ministries of Health, Labour and the Environment, which is to be carried out in designated Ontario elementary schools during the fall. Schools in our area, including your own, have been randomly chosen to take part. Your co-operation and support and that of your staff are requested for this important project.

Lead at high levels is known to have harmful effects on young children, particularly on their mental development. The purpose of the testing program is to determine the blood lead levels of junior and senior kindergarten and Grade 1 children in schools in representative areas of the province. Hitherto, research has concentrated on known high lead areas, but baseline information is also required on the distribution of blood lead levels in children who live in other settings, urban, suburban and rural.

It is important that the testing take place as soon as possible after the summer holiday period, when lead levels tend to be at their highest. Although September is a very busy time for the schools, we are assured that every effort will be made to keep disruption of the work of the school to a minimum.

The Interministerial Committee, which is responsible for this initiative, has commissioned the firm of A.R.A. Consultants to carry out the testing program within the schools. During the next week, A.R.A. will contact you with further information on the background and proposed conduct of the project. Ms. Judith Sylph, their co-ordinator, will also get in touch with you to discuss the most appropriate timing of the program from your point of view, and to work out all details and arrangements. A.R.A. will work independently as far as possible and will provide all necessary materials and staff for their time (perhaps 1-2 days) in the school.

Thanking you for your support,

Yours sincerely,

School Board

DRAFT LETTER FROM A.R.A. TO PRINCIPALS

Dear Principal:

Recently, the Director of Education contacted you to request your support for a blood lead testing program to be carried out among junior and senior kindergarten and Grade 1 children in selected Ontario schools, of which your school is one. The three ministries (Health, Labour and the Environment) responsible for this initiative have retained our firm to carry out the project within the schools. I am therefore writing to give you information on the rationale of the program and to discuss possible approaches to its implementation in the school.

Lead has found its way into the environment from an increasing number of sources, from gasoline emissions from vehicles and smelters to factories using lead. While lead at high levels is known to affect young children adversely, leading in extreme cases to significant mental and nervous impairment, little is known of the distribution of blood lead levels in the population at large. To date, research has focussed on urban areas near known lead sources, and insufficient information is available on lead levels in children who live in more representative urban, rural and suburban areas. It is hoped that the present study will provide this information for children in the province.

While we appreciate that September is a very busy time for schools, it is important that the testing be carried out as soon after the summer holiday period as possible. Lead levels tend to be highest during the summer months when children spend a great deal of time playing outdoors. We plan to begin testing as early as possible in September and to complete the program within six weeks. We estimate that we would spend a maximum of 1-1/2 days in each school.

We will make every effort to ensure the least possible disruption of the work of the school, providing our own materials and staff and, as far as possible, working independently. We would, however, request the cooperation of classroom teachers in the distribution and collection of consent forms for parents. A.R.A. staff will be responsible for all other arrangements before, during and after the testing. Experienced Registered Nurses will take small blood samples from the fingertip of each child whose parents consent to his/her participation. A.R.A. supervisory staff will be present throughout to supervise and coordinate all aspects of the program. After the blood sampling, parents will be contacted for home interviews by A.R.A. staff to determine the presence of risk factors for lead in the child's environment. Parents with other children whom they would like to have tested may enter their name on the consent form and we will make separate arrangements for them.

Results of the blood lead testing for each child will be communicated directly to individual parents, with a brief explanation of the results for their child(ren). A copy of the results will also be sent to the Medical

Officer in each district for follow-up if necessary. Throughout the project, we will maintain close contact with the Medical Officers of Health and with nurses within the selected schools.

Dr. Shelagh Emmott, one of our senior consultants, is responsible for directing the project, and Ms. Judith Sylph is our field coordinator. Shortly after you receive this letter, Ms. Sylph will contact you to discuss how best the project might be carried out in your school. She will coordinate arrangements such as the appropriate timing for the project, the selection of a suitable room in which the testing can be performed, the distribution of parental consent forms, and other matters.

For your further information, I am enclosing a copy of the letter we propose to send to parents, together with the consent form. We have been advised that a covering letter from the School Principal would ensure a better response from parents and we would very much appreciate it if you could provide us with such a letter. To save you time, you may wish to use the enclosed draft as a basis.

We thank you very much for your support and cooperation.

Yours sincerely,

A.R.A. CONSULTANTS

Paul R.A. Stanley
Partner

PRAS/sjl
Encls.

November 6, 1984

REF: 84075

ARA

Dear Parent or Guardian:

As you may know, there has been interest in the possible effects on children's health of lead from the environment, such as gasoline fumes from cars, paint and other sources. At present, little is known about how much Ontario children might be affected.

The Ministry of Health has asked our firm, A.R.A. Consultants, to carry out a blood testing program in different parts of Ontario. The purpose of the program is to find out how much lead children who live in typical city, suburban and rural areas have in their blood.

Your area of the province and your child's school have been randomly chosen to take part in this project. We hope to take small samples of blood from all pupils in your child's class.

If you would like your child to be included in the program, please sign the enclosed consent form and return it to the school within the next two days. We can also test any younger children you may have at home. If you would like to have this done, please add their names to the form and we will include them separately. We will contact you about these arrangements later.

The testing of the school children at the school will be carried out by Registered Nurses with special training and experience with children. The test consists of a small prick in the child's finger to draw a few drops of blood which will be sent for laboratory analysis. The results of the test for your child, and an explanation of its meaning will be mailed to you.

To help us to understand the results, we also need information on each child's activities, home and neighbourhood. During the next few weeks, one of our field staff may contact the parents of children who have been tested to arrange a short interview in the home. We would very much appreciate your taking part.

If you have any questions about the project, please contact Judith Sylph or myself at A.R.A. Consultants, (416) 961-1474. Your child's participation can be of great help in adding to our knowledge of this important issue.

Sincerely,

A.R.A. CONSULTANTS

Shelagh Emmott
Senior Consultant

SUPPLIES

Serial No. / / / / / / / / / /

MINISTRY OF HEALTH
BLOOD LEAD TESTING PROGRAM
CONSENT

Name of child: _____
Surname First Name

Address: _____
Postal Code

Telephone: _____ Sex: _____ Date of Birth: _____
M/F

Name(s) of other child(ren) to be tested _____ Sex: _____ Date of Birth: _____
M/F
_____ Sex: _____ Date of Birth: _____
M/F

I give consent _____ (Please check one)
I do not consent _____

for the above child(ren) to take part in the Ministry of Health blood lead testing program at his/her school.

I understand that a Registered Nurse will take a finger-prick blood sample from each child. This involves a quick prick in the finger to obtain a few drops of blood in a small tube. I also understand that program staff may contact me later to arrange a short home interview. The results of the test will be mailed to me.

Signature of Parent/Guardian

PLEASE RETURN THIS FORM TO YOUR CHILD'S TEACHER WITHIN THE NEXT TWO DAYS
WHETHER YOU HAVE GIVEN CONSENT OR NOT.

BLOOD LEAD STUDY
DRAFT LETTER TO PARENT FROM PRINCIPALS

Dear Parent:

Our school has been selected by the Ministry of Health to participate in a province-wide program to test the blood of Ontario children for the presence of lead. All children six years and under will be invited to take part in the testing, which will be carried out in the school next week on

The purpose of the program and all other necessary information is contained in the letter below. We are pleased to support this important program and we hope that you, as parents, will do so too. A consent for for your signature is enclosed and, if you would like your child to take part, please complete and return it to the school by

Yours sincerely,

Principal

Encl.

SUPPLIES

The following supplies were obtained to test approximately 1,300 children for blood lead using the finger-prick method.

Medical Supplies

	<u>Quantity</u>
Becton-Dickson Autoclix lancets (BD2904-3)	7 packages of 200
Becton-Dickson plastic heparinized microtainers with collector-tops (BD5961)	70 boxes of 20
alcohol wipes	70 boxes of 20
gauze squares, 2" x 2"	115 boxes of 100
small size bandages	70 boxes of 20
surgical gloves	small size - 1 box medium size - 1 box
plastic kidney basins	2

Non-Medical Supplies

white labels for microtainers	2 packages of 800
small ice-packs	12
styrofoam ice-chest	2
facial tissues	16 boxes
soap (plain, unscented, white)	4 dozen bars
brown paper sandwich bags (for used lancets)	6 packages
paper towels (non-recycled material)	30 rolls
white plastic garbage bags	6 packages
plastic nail brushes	4
aprons for nurses	4

Non-Medical Supplies (continued)

Quantity

plastic tablecloths	4 rolls
liquid bleach	2 jugs
sugarless lollipops for children	1,320
fuzzy stickers for children	1,320

Office Supplies

stapler	1
staples	1 box
pencils, sharpened	1 box
scissors	2 pair
masking tape	4 rolls
paperclips	1 box
pads of paper	6#
nominal rolls and testing records	as required

BLOOD LEAD LABORATORY ANALYSIS PROCEDURE

BLOOD LEAD LABORATORY ANALYSIS PROCEDURE

Blood samples were analyzed by the atomic absorption spectrophotometry method at the Ministry of Health Laboratories in Toronto. Two assays of each blood sample were done. A sample volume of at least 50 uL was established as the minimum for testing.

ANALYTICAL METHOD FOR THE DETERMINATION OF LEAD IN WHOLE BLOOD

A. Apparatus and Instrument Setting

A Hitachi Zeeman Graphite Furnace Atomic Absorption Spectrophotometer, Model 180-80, equipped with a Hitachi data processing unit, Model 180-0205 and an automatic sampler, No. 180-0127 were used. A standard graphite cup-type cuvette from Ringsdorff, West Germany, was employed. The instrumental parameter settings were:

Wavelength:	283.3nm
Lamp Current:	7.5 mA
Slit:	1.3 nm
Analytical Mode:	Concentration
Measurement Mode:	Peak Area
Equation Type:	Linear Fit
Background Corrector:	Zeeman AA

To improve the precision and accuracy of the pipetting system, a MICRO LAB M pipettor from Hamilton, Switzerland was used to deliver the matrix solution.

B. Analytical Procedure

The blood lead of the sample was determined using a Graphite Furnace procedure with (NH₄)₂HPO₄: Triton X-100 matrix modification (1,2). The blood sample in each microtainer was vortexed for at least 30 seconds. A 50 uL aliquot of the sample was then pipetted into a small tube with 450 uL of 12.5 g/L (NH₄)₂HPO₄: 5 g/L Triton X-100. The tube was

then vortexed and transferred to the 2 mL plastic sample cups placed in the autosampler.

Ten microliters of the diluted sample was transferred to a graphite cup-type cuvette by the autosampler. The blood lead was then analyzed under the optimized operating conditions shown below:

Drying:	40 - 100°C,	60 s
Ashing:	400°C	30 s
Atomization:	1800°C	7 s
Cleaning:	2100°C	3 s
Carrier Gas:	Argon,	200 mL/min

The concentration of the blood specimens was calculated by the help of a freshly prepared aqueous standard curve consisting of a blank and three aqueous standards (25,50 and 100 ug/L) in the matrix solution of (NH₄)₂HPO₄: Triton X-100. Since the blood specimen was diluted 10 times, the aqueous standards would correspond to 250,500 and 1,000 ug/L of Pb in the whole blood sample. A duplicate analysis was run throughout the entire study.

Two quality control specimens (M1 and M2) from Behring Institute, West Germany, were assayed the same way as the blood specimens.

References

1. Wang ST, Strunc G and Peter F. Determination of Cadmium and Lead in Whole Blood and Urine by Zeeman Flameless Atomic Absorption Spectroscopy. Chemical Toxicology and Clinical Chemistry of Metals edited by Stanley S. Brown & John Savory, Academic Press, p. 57-60 (1983)
2. Wang ST and Peter F. The stability of Human Blood Lead in Storage. J. Anal. Toxicology 9, March 1985.

C. Accuracy of Procedure

The accuracy of the analytical procedure was verified by the results the Ministry of Health Laboratory reported to the U.S. Centres for Disease Control (CDC) Toxicology Blood Lead Proficiency Testing Program. All results the laboratory submitted to CDC in the fourth quarter of 1983 and in the first quarter of 1984 obtained the highest rating. That is, all results were within the acceptable limits set up by CDC. Based on this performance, the Biochemistry Laboratory of the Ministry of Health was approved in March 1984, for blood lead analysis by the Occupational Safety and Health Administration (OSHA), U.S. Department of Labor. The precision of the method was determined by the laboratory in our specimens, representing ranges of 0-10, 10-20, 20-30 and 30-50 ug/dL concentrations. The coefficient of variation values (CV) were 11.2% for the specimen in the 0-10 ug/dL range, 5.2% in the 10-20 ug/dL range, 2.8% for the 20-30 ug/dL range and 2.7% for the 30-50 ug/dL range.

D. Differences Between Analyses

The single blood sample taken from each child was tested twice by the Ministry of Health Laboratory. The mean difference between the two samples was not significantly different (Wilcoxon = 329726.0, $p = n.s.$).

The following table presents data on the two laboratory samples. As can be noted, they were virtually identical.

	<u>Sample 1</u>	<u>Sample 2</u>
N	1269	1269
Mean	.54	.54
Median	.49	.49
S.D.	.32	.32

REPORT OF RESULTS TO PARENTS

November 23, 1984

REF: 84075

Dear Parent/Guardian:

We have received the results of the blood lead testing which was recently carried out in certain Etobicoke schools.

The blood sample for your child, _____, which was analyzed by the Ministry of Health laboratories in Toronto, was found to contain ____ umol/L (micromoles of lead per litre of whole blood).

Previous surveys of blood lead levels have found the most common range for rural residents to be from 0.24 to 0.72 umol/L, and for city residents from 0.24 to 1.45 umol/L. Above the cut-off point of 1.45 umol/L, medical attention is recommended and children are referred to the local Medical Officer of Health for retesting and follow-up. Elevation above the normal range may be simply due to contamination during the test procedure (e.g., the child's hands were inadequately washed during preparation for the test).

Your child's name has, therefore, been passed to the Medical Officer of Health, who will contact you to advise you of the steps to be taken to retest and examine your child.

If you have any questions or concerns about the test or your child's results, please telephone Dr. Shelagh Emmott or Judith Sylph at A.R.A. Consultants, (416)961-1474.

We thank you very much for your participation in this program.

Sincerely,

A.R.A. CONSULTANTS

Shelagh Emmott, Ph.D.
Senior Consultant

November 23, 1984

REF: 84075

Dear Parent/Guardian:

We have received the results of the blood lead testing which was recently carried out in certain Etobicoke schools.

The blood sample for your child, _____, which was analyzed by the Ministry of Health laboratories in Toronto, was found to contain ____ umol/L (micromoles of lead per litre of whole blood).

Previous surveys of blood lead levels have found the most common range for rural residents to be from 0.24 to 0.72 umol/L, and for city residents from 0.24 to 1.45 umol/L. Above that level (1.45 umol/L), the Ontario Ministry of Health and the Environmental Protection Agency in the U.S.A. considers that medical attention should be sought.

As you will see from the above, your child's result is within the normal range and no medical attention is necessary.

If you have any questions or concerns about the test or your child's results, please telephone Dr. Shelagh Emmott or Judith Sylph at (416)961-1474.

We thank you very much for your participation in this program.

Sincerely,

A.R.A. CONSULTANTS

Shelagh Emmott, Ph.D.
Senior Consultant

November 23, 1984

REF: 84075

Dear Parent/Guardian:

We have received the results of the blood lead testing which was recently carried out in certain Etobicoke schools.

The blood sample for your child, _____, which was analyzed by the Ministry of Health laboratories in Toronto, was found to contain ____ umol/L (micromoles of lead per litre of whole blood).

Previous surveys of blood lead levels have found the most common range for rural residents to be from 0.24 to 0.72 umol/L, and for city residents from 0.24 to 1.45 umol/L. Above that level (1.45 umol/L), the Ontario Ministry of Health and the Environmental Protection Agency in the U.S.A. recommends that medical attention should be sought and the child retested. Elevation above the normal range may be simply due to contamination during the test procedure.

As you will see from the above, though slightly elevated, your child's result is within the normal range. However, if you are concerned, you may ask your school nurse or family doctor to contact the local Medical Officer of Health to arrange retesting and follow-up for your child.

If you have any questions or concerns about the test or your child's results, please telephone Dr. Shelagh Emmott or Judith Sylph at A.R.A. Consultants, (416)961-1474.

We thank you very much for your participation in this program.

Sincerely,

A.R.A. CONSULTANTS

Shelagh Emmott, Ph.D.
Senior Consultant

QUESTIONNAIRE

TO INTERVIEWER:
Record in Col. 16
Present Residence is:
1. House
2. Apartment

Serial # 2/3/4/5/6/7/8/9/
Name of Interviewer 10/11/
Date of Interview 12/13/14/15/
Day Month

BLOOD LEAD QUESTIONNAIRE

16/17/
16

1. (a) Name of Tested Child: _____

(b) Date of Birth: _____

17/18/19/20/21/22/
DD MM YY

(c) Child's Age: _____

23/
23

2. Name of Person Interviewed: _____

Relationship to Child: _____

24/
24

3. Number of adults living at home:

Total 25/26/
25 26

a. Mother _____

Number

27/
27

b. Father _____

28/
28

c. Step-parent or guardian _____

29/
29

d. Grandparents or
other relative _____

30/
30

e. Unrelated others _____

31/
31

4. Number of children living at home:

Number of
Children

Tested?
1=Yes 2=No

a. Aged under 1 year

32/
32

33/
33

b. Aged 1-3 years

34/
34

35/
35

c. Aged 4-6 years

36/
36

37/
37

d. Aged 7-12 years

38/
38

39/
39

e. Aged 13-18 years

40/
40

41/
41

f. Over 18 years

42/
42

43/
43

Name(s) of any other Child(ren) in
residence Tested

Age

Name: _____

Name: _____

5. Is there a family doctor? 1 Yes
2 No

44/
44

Name of family physician _____

Address _____

Phone Number _____

Occupational Data

IF FATHER (INCLUDING STEPFATHER) HAS LIVED WITH CHILD WITHIN THE LAST YEAR:

6. a. Father's Current Occupation: _____
- b. Lead Worker: 1 Yes 2 No / /
45
- c. Is father tested for lead at work? 1 Yes 2 No / /
46
- d. Father's Part-Time Occupation: _____
- e. Lead Worker: 1 Yes 2 No / /
47
- f. Previous Occupation Within Lifetime of Child: _____
- g. Lead Worker: 1 Yes 2 No / /
48

IF MOTHER (INCLUDING STEPMOTHER) HAS LIVED WITH CHILD WITHIN THE LAST YEAR:

7. a. Mother's Current Occupation: _____
- b. Lead Worker? 1 Yes 2 No / /
49
- c. Is mother tested for lead at work? 1 Yes 2 No / /
50
- d. Mother's Part-Time Occupation: _____
- e. Lead Worker? 1 Yes 2 No / /
51
- f. Previous Occupation Within Lifetime of Child: _____
- g. Lead Worker? 1 Yes 2 No / /
52

8. OTHER ADULT LIVING WITH CHILD:

- a. Current Occupation: _____
- b. Lead Worker: 1 Yes 2 No / /
53
- c. Is Adult tested for lead at work? 1 Yes 2 No / /
54
- d. Part-time Occupation: _____
- e. Lead Worker? 1 Yes 2 No / /
55
- f. Previous Occupation Within Lifetime of Child: _____
- g. Lead Worker: 1 Yes 2 No / /
56

9. Other Adult Living With Child:

- a. Current Occupation: _____
- b. Lead Worker: 1 Yes 2 No / /
57
- c. Is Adult tested for lead at work? 1 Yes 2 No / /
58
- d. Part-time Occupation: _____
- e. Lead Worker? 1 Yes 2 No / /
59
- f. Previous Occupation Within Lifetime of Child: _____
- g. Lead Worker: 1 Yes 2 No / /
60

[For the following questions about residence(s) (house/apartment), answer in terms of the 3 residences lived in for the longest period of time during the lifetime of the child. If the family has lived in a single residence for 75% of the lifetime of the child, ask for information about only that one residence.]

Residential Data: Present or Main Residence

10. Age of residence: _____ (years)

/ /
61 62

11. How long have you lived in this residence _____ (years) (Round up to next year)

/ /
63 64

12. Type of construction: (check primary material)

- | | |
|---------|--------------------|
| 1 Brick | 4 Aluminum Siding |
| 2 Wood | 5 Stucco |
| 3 Stone | 6 Insulbrick |
| | 7 Other (describe) |

/ /
65

13. Is the exterior of the residence painted?

- 1 Yes 2 No 3 Trim only

/ /
66

14. What per cent of exterior is painted? _____ (%) (88 = not applicable)

/ /
67 6815. When was the exterior of the residence last painted? _____ (year)
(88 = not applicable) (99 don't know)/ /
69 70

16. Is the residence built on landfill?

- 1 Yes
-
- 2 No
-
- 3 Don't Know

/ /
71

17. Has topsoil been added to the yard for any reason (e.g. construction, adding a garden)?

- 1 Yes
-
- 2 No
-
- 3 Don't Know

/ /
72

18. Are there any unsodded bare patches of exposed soil in the yard?

- 1 Yes
-
- 2 No

/ /
73

19. Is there a vegetable garden?

- 1 Yes
-
- 2 No

/ /
74

20. Where does the child usually play outdoors?

- 1 Own yard
-
- 2 Friends' yards
-
- 3 Street
-
- 4 Park (name?) _____
-
- 5 Other _____

/ /
75

21. How much of the ground in the child's favourite area is bare, unsodded ground?

_____ %

/ /
76 77

22. Type of heating:

1. Oil - forced air
2. Oil - hot water/radiators
3. Gas - forced air
4. Gas - hot water/radiators
5. Hydro
6. Wood Stove
7. Hot Water/Radiators

/2/

23. a) Do you have an open fireplace?

- 1 Yes
- 2 No

/3/

b) (If yes,) How often is it used (in cold weather)

- 1 Daily
- 2 Weekly
- 3 Monthly
- 4 Never

/4/

c) Are papers with coloured inks (eg. comics or advertising circulars) burned in the fireplace?

- 1 Yes
- 2 No

/5/

24. Is there forced air heating?

- 1 Yes
- 2 No

/6/

25. a) Is there an air filter?

- 1 Yes
- 2 No

/7/

b) Is there an air cleaner?

- 1 Yes
- 2 No

/8/

c) Is there an air conditioner?

- 1 Yes
- 2 No

/9/

If YES:

- 1 Individual Rooms
- 2 Central

/10/

26. a) Have there been any major renovations in life of child? (Describe)

- 1 Yes
- 2 No

/11/

b) If yes, did these include:

- 1 Sanding or sandblasting of paint?
- 2 Removal of walls?
- 3 Plumbing work involving installation or repair of pipes?
- 4 Other (describe) _____

/12/13/14/15/

27. What is the source of the water supply?

1 City water

2 Well water

3 Other (specify) _____

28. Within 6 blocks (1/2 mile) of your residence, how many of the following are there:

a. gas stations

b. 4-lane roads

c. minor highways

d. major highways

e. major industries
(describe)

/16/

/17/

/18/

/19/

/20/

/21/

29. Within 1 block of your residence, how many of the following are there:

a. gas stations

b. 4-lane roads

c. minor highways

d. major highways

e. major industries
(describe)

/22/

/23/

/24/

/25/

/26/

30. Please describe the road on which your residence is situated:

1 Highway

2 Major commercial

3 Some commercial

4 Residential

5 Rural

/27/

IF ONLY ONE RESIDENCE IN LIFE OF CHILD GO TO PAGE 12

Residential Data: Past Residence #1

31. Age of residence: _____ (years)

/ 28 / 29 /

32. How long did you live in this residence? _____ (years) (Round up to next year)

/ 30 / 31 /

33. Type of construction: (check primary material)

- | | |
|---------|--------------------|
| 1 Brick | 4 Aluminum Siding |
| 2 Wood | 5 Stucco |
| 3 Stone | 6 Insulbrick |
| | 6 Other (describe) |

/ 32 /

34. Was the exterior of the residence painted?

- | | | |
|-------|------|-------------|
| 1 Yes | 2 No | 3 Trim only |
|-------|------|-------------|

/ 33 /

35. What per cent of exterior was painted? _____ (%) (88 = not applicable)

/ 34 / 35 /

36. When was the exterior of the residence last painted? _____ (year)
(88 = not applicable) (99 = don't know)

/ 36 / 37 /

37. Was the house built on landfill?

- | |
|--------------|
| 1 Yes |
| 2 No |
| 3 Don't Know |

/ 38 /

38. Was topsoil added to the yard for any reason (e.g. construction, adding a garden)?

- | |
|--------------|
| 1 Yes |
| 2 No |
| 3 Don't Know |

/ 39 /

39. Were there any unsodded bare patches of exposed soil in the yard?

- | |
|-------|
| 1 Yes |
| 2 No |

/ 40 /

40. Was there a vegetable garden?

- | |
|-------|
| 1 Yes |
| 2 No |

/ 41 /

41. Where did the child usually play outdoors?

- | |
|----------------------|
| 1 Own yard |
| 2 Friends' yards |
| 3 Street |
| 4 Park (name?) _____ |
| 5 Other _____ |

/ 42 /

42. How much of the ground in the child's favourite area was bare, unsodded ground?

_____ %

/ 43 / 44 /

43. Type of heating:

/ 45 /

1. Oil - forced air
2. Oil - hot water/radiators
3. Gas - forced air
4. Gas - hot water/radiators
5. Hydro
6. Wood Stove
7. Hot Water/Radiators

44. a) Did you have an open fireplace?

- 1 Yes
- 2 No

/ 46 /

b) (If yes,) How often was it used (in cold weather)

- 1 Daily
- 2 Weekly
- 3 Monthly
- 4 Never

/ 47 /

c) Were papers with coloured inks (eg. comics or advertising circulars) burned in the fireplace?

- 1 Yes
- 2 No

/ 48 /

45. Was there forced air heating?

- 1 Yes
- 2 No

/ 49 /

46. a) Was there an air filter?

- 1 Yes
- 2 No

/ 50 /

b) Was there an air cleaner?

- 1 Yes
- 2 No

/ 51 /

c) Was there an air conditioner?

- 1 Yes
- 2 No

/ 52 /

d) If YES:

- 1 Individual Rooms
- 2 Central

/ 53 /

47. Had there been any major renovations in life of child? (Describe)

- 1 Yes
- 2 No

/ 54 /

If yes, did these include:

- 1 Sanding or sandblasting of paint?
- 2 Removal of walls?
- 3 Plumbing work involving installation or repair of pipes?
- 4 Other (describe) _____

/ 54 55 56 57 /

48. What was the source of the water supply?

- 1 City water
- 2 Well water
- 3 Other (specify) _____

/ 58 /

49. Within 6 blocks (1/2 mile) of your residence, how many of the following were there:

- a. gas stations _____
- b. 4-lane roads _____
- c. minor highways _____
- d. major highways _____
- e. major industries (describe) _____

/ 59 /

/ 60 /

/ 61 /

/ 62 /

/ 63 /

50. Within 1 block of your residence, how many of the following were there:

- a. gas stations _____
- b. 4-lane roads _____
- c. minor highways _____
- d. major highways _____
- e. major industries (describe) _____

/ 64 /

/ 65 /

/ 66 /

/ 67 /

/ 68 /

51. (a) Please describe the road on which your residence was situated:

/ 69 /

- 1 Highway
- 2 Major commercial
- 3 Some commercial
- 4 Residential
- 5 Rural

SERIAL # / 70 / 71 / 72 / 73 / 74 / 75 / 76 / 77 /

(b) Was past residence #1, a

- 1 house
- 2 apartment

/ 78 /

/3/ /2/3/4/5/6/7/8/9/

Residential Data: Past Residence #2

52. Age of residence: _____ (years)

/10/11/

53. How long did you live in that residence? _____ (years) (Round up to next year)

/12/13/

54. Type of construction: (check primary material)

- | | |
|---------|--------------------------|
| 1 Brick | 4 Aluminum Siding |
| 2 Wood | 5 Stucco |
| 3 Stone | 6 Insulbrick |
| | 7 Other (describe) _____ |

/14/

55. Was the exterior of the residence painted?

- | | | |
|-------|------|-------------|
| 1 Yes | 2 No | 3 Trim only |
|-------|------|-------------|

/15/

56. What per cent of exterior was painted? _____ (%) (88 = not applicable)

/16/17/

57. When was the exterior of the residence last painted? _____ (year)
(88 = not applicable) (99 = don't know)

/18/19/

58. Was the residence built on landfill?

- | |
|--------------|
| 1 Yes |
| 2 No |
| 3 Don't Know |

/20/

59. Had topsoil been added to the yard for any reason (e.g. construction, adding a garden)?

- | |
|--------------|
| 1 Yes |
| 2 No |
| 3 Don't Know |

/21/

60. Was there any unsodded bare patches of exposed soil in the yard?

- | |
|-------|
| 1 Yes |
| 2 No |

/22/

61. Was there a vegetable garden?

- | |
|-------|
| 1 Yes |
| 2 No |

/23/

62. Where did the child usually play outdoors?

- | |
|----------------------|
| 1 Own yard |
| 2 Friends' yards |
| 3 Street |
| 4 Park (name?) _____ |
| 5 Other _____ |

/24/

63. How much of the ground in the child's favourite area was bare, unsodded ground?

_____ %

/25/26/

64. Type of heating:

/ 27 /

1. Oil - forced air
2. Oil - hot water/radiators
3. Gas - forced air
4. Gas - hot water/radiators
5. Hydro
6. Wood Stove
7. Hot Water/Radiators

65. Did you have an open fireplace?

- 1 Yes
- 2 No

/ 28 /

(If yes,) How often was it used (in cold weather)

- 1 Daily
- 2 Weekly
- 3 Monthly
- 4 Never

/ 29 /

Were papers with coloured inks (eg. comics or advertising circulars) burned in the fireplace?

- 1 Yes
- 2 No

/ 30 /

66. Was there forced air heating?

- 1 Yes
- 2 No

/ 31 /

67. a) Was there an air filter?

- 1 Yes
- 2 No

/ 32 /

b) Was there an air cleaner?

- 1 Yes
- 2 No

/ 33 /

c) Is there an air conditioner?

- 1 Yes
- 2 No

/ 34 /

If YES:

- 1 Individual Rooms
- 2 Central

/ 35 /

68. Had there been any major renovations in life of child? (Describe)

- 1 Yes
- 2 No

/ 36 /

If yes, did these include:

- 1 Sanding or sandblasting of paint?
- 2 Removal of walls?
- 3 Plumbing work involving installation or repair of pipes?
- 4 Other (describe) _____

/ 37 38 39 40 /

69. What was the source of the water supply?

- 1 City water
- 2 Well water
- 3 Other (specify) _____

/41/

70. Within 6 blocks (1/2 mile) of your residence, how many of the following were there:

- a. gas stations _____
- b. 4-lane roads _____
- c. minor highways _____
- d. major highways _____
- e. major industries (describe) _____

/42/
/43/
/44/
/45/
/46/

71. Within 1 block of your residence, how many of the following were there:

- 1 gas stations _____
- 2 4-lane roads _____
- 3 minor highways _____
- 4 major highways _____
- 5 major industries (describe) _____

/47/
/48/
/49/
/50/
/51/

72. Please describe the road on which your residence was situated:

/52/

1. Highway
2. Major commercial
3. Some commercial
4. Residential
5. Rural

72. (a) Is past residence #2 a:

1. house
2. apartment

/53/

FAMILY ACTIVITIES

73. Does any family member take part in the following hobbies at home?

- | | | | |
|--------------------------|-------|------|--------|
| a. Soldering | 1 Yes | 2 No | / 54 / |
| b. Painting | 1 Yes | 2 No | / 55 / |
| c. Stained Glass | 1 Yes | 2 No | / 56 / |
| d. Pottery Glazing | 1 Yes | 2 No | / 57 / |
| e. Auto Repairing | 1 Yes | 2 No | / 58 / |
| f. Furniture Refinishing | 1 Yes | 2 No | / 59 / |

74. a) Do you cook with vegetables from your own garden?

- 1 Yes
2 No

/ 60 /

b) How often? During summer:

- 1 Daily
2 Weekly
3 Monthly

/ 61 /

During winter:

- 1 Daily
2 Weekly
3 Monthly

/ 62 /

75. a) Do you use canned milk?

- 1 Yes
2 No

/ 63 /

b) If YES, How often?

- 1 Daily
2 Weekly
3 Monthly

/ 64 /

c) Brand Name? _____

76. a) Do you use an electric kettle?

- 1 Yes
2 No

/ 65 /

b) If YES, brand name? _____

c) How old is it? _____ (years)

/ 66 67 /

77. a) Are there any pets in the residence?

- 1 Yes
2 No

/ 68 /

b) If YES:

a. Number of cats _____

/ 69 /

b. Number of dogs _____

/ 70 /

c. Other (describe) _____

/ 71 /

78. Has the child chewed on non-food items such as toys or window sills within the last three months?

- 1 Yes
- 2 No

/ 12 /

If YES, please describe.

79. Does the child take any supplements, tonics or regular medication?

- 1 Yes
- 2 No

/ 13 /

If YES, brand name _____

80. a) Has the child taken any supplements/medication during last three months? / 14 /

- 1 Yes
- 2 No

b) Describe: _____ / 15 /

***** / 16 / 17 / 18 / 19 / 20 / 21 / 22 / 23 / 24 / 25 /

INSPECTION QUESTIONS

Request permission to inspect the pipes in the kitchen, bathroom and basement.
If respondent refuses the inspection, ask for verbal responses about pipes.

81. Kitchen: 1 = Inspected 2 = Inspection Refused

/ 10 /

82. Type of pipes (plumbing): (inspect kitchen)

- 1 Galvanized Iron
- 2 Copper
- 3 Lead
- 4 Plastic
- 5 Combination (without lead)
- 6 Combination (with lead)

/ 11 /

83. Bathroom: 1 = Inspected 2 = Inspection Refused

/ 12 /

84. Type of pipes (plumbing): (inspect bathroom)

- 1 Galvanized Iron
- 2 Copper
- 3 Lead
- 4 Plastic
- 5 Combination (without lead)
- 6 Combination (with lead)

/ 13 /

85. Basement: 1 = Inspected 2 = Inspection Refused 3 = Apartment, inspection not possible / /
14

86. Type of pipes (plumbing): (inspect basement)

- 1 Galvanized Iron
- 2 Copper
- 3 Lead
- 4 Plastic
- 5 Combination (without lead)
- 6 Combination (with lead)

/ /
15

87. Child's Room: 1 = Inspected 2 = Inspection Refused

/ /
16

88. Child's Room (inspect)

a) Flooring:

- 1 Broadloom
- 2 Bare Hardwood
- 3 Area Rugs
- 4 Linoleum
- 5 Other (specify) _____

/ /
17

b) Condition
of Paint

- 1 Peeling
- 2 Some Peeling
- 3 No Peeling

/ /
18

89. Favorite Play Area: 1 = Inspected 2 = Inspection Refused

/ /
19

90. What area is the child's favourite play area inside the home? (inspect)

a) Flooring:

- 1 Broadloom
- 2 Bare Hardwood
- 3 Area Rugs
- 4 Linoleum
- 5 Other (specify) _____

/ /
20

b) Condition of Paint:

- 1 Peeling
- 2 Some Peeling
- 3 No Peeling

/ /
21

91. Condition of exterior paint: (inspect)

- 1 Peeling
- 2 Some Peeling
- 3 No Peeling

/ /
22

Thank you very much for your cooperation. You will be receiving the results of your child's blood test for lead within two weeks of this interview.

Address of child: _____

Telephone Number: _____

SOIL ANALYSIS TECHNIQUE

SOIL ANALYSIS

The analysis of soil samples for this study was carried out by the Laboratory Services Branch of the Ministry of the Environment. Sample aliquots consisting of 0.5 g of dried, sieved soil were digested on a hot block for 8.5 hours in 6 ml of a 3:1 v/v solution of HCl: HNO₃. After dilution to 25 ml volume, lead concentrations were measured using a Perkin-Elmer 5000 atomic absorption spectrophotometer at a wave length of 283.3 nm. Quality control was maintained by simultaneous analysis of a control soil sample of known lead concentration with each batch of 40 samples and by duplicate analysis of every tenth sample.

WATER ANALYSIS

WATER ANALYSIS

The analysis of water samples for this study was conducted by the laboratories of Barringer Research Incorporated, a division of Barringer-Magenta. Water samples were analyzed for lead using a Varian model AA-475 Atomic Absorption Spectrophotometer equipped with a Perkin Elmer model HG 2100 graphite furnace. The wave length used was 283.3 nm. The system was calibrated with standard lead solutions before analysis of the samples. Ten percent of the sites were analyzed in replicate. Blank solutions of distilled deionized water were analyzed every fifth sample and control solutions of known lead concentration were analyzed every twenty samples.

DESCRIPTION OF SAMPLE OF INTERVIEW FAMILIES

TABLE K-1

Q1 - Child's Age at Time of Blood-Lead Testing

Site	Child's Age							Total
	1 Year or less	2 Years	3 Years	4 Years	5 Years	6 Years	6 Years or more	
Windsor								
N	3	3	3	16	69	41	-	135
% per site	2.2%	2.2%	2.2%	11.9%	51.1%	30.4%	-	100%
Toronto								
N	2	-	12	41	47	29	3	134
% per site	1.5%	-	9.0%	30.6%	35.1%	21.6%	2.2%	100%
Scarborough								
N	-	2	20	49	30	33	-	134
% per site	-	1.5%	14.9%	36.6%	22.4%	24.6%	-	100%
Etobicoke								
N	-	1	31	35	34	31	-	132
% per site	-	0.8%	23.5%	26.5%	25.7%	23.5%	-	100%
Walpole								
N	2	-	6	13	66	46	2	135
% per site	1.5%	-	4.4%	9.6%	48.9%	34.1%	1.5%	100%
Longwoods								
N	-	-	14	18	51	52	-	135
% per site	-	-	10.4%	13.3%	37.8%	38.5%	-	100%
Total								
N	7	6	86	172	297	232	5	805
% across sites	0.9%	0.7%	10.7%	21.4%	36.9%	28.8%	0.6%	100%

Note : Sites differ significantly; using age categorized as: 1) less than 4 years;
 2) 4 years; 3) 5 years; 4) 6 years; (children over 6 set to missing);
 chi-square (df = 15) = 122, p < .001.

TABLE K-2
Sex of Tested Child

<u>Site</u>	<u>Males</u>	<u>Females</u>	<u>Total</u>
Windsor			
N	64	71	135
% per site	47.4%	52.6%	
Toronto			
N	61	73	134
% per site	45.5%	54.5%	
Scarborough			
N	73	61	134
% per site	54.5%	45.5%	
Etobicoke			
N	62	70	132
% per site	47.0%	53.0%	
Walpole			
N	74	61	135
% per site	54.8%	45.2%	
Longwoods			
N	64	71	135
% per site	47.4%	52.6%	
Total			
N	398	407	805
% across sites	49.4%	50.6%	100%
	<u> </u>	<u> </u>	<u> </u>

Note: Sites differ significantly; chi-square (df = 4) = 13.1, p <.001.

TABLE K-3

Q2 - Number of Adults Living at Home by Site

Site	Number of Adults					Total
	1	2	3	4	5	
Windsor						
N	22	102	7	3	1	135
% per site	16.3%	75.6%	5.2%	2.2%	0.7%	
Toronto						
N	59	63	9	3	-	134
% per site	44.0%	47.0%	6.7%	2.2%	-	
Scarborough						
N	9	111	7	4	3	132
% per site	6.7%	82.8%	5.2%	3.0%	2.2%	
Etobicoke						
N	2	108	18	3	1	135
% per site	1.5%	81.8%	13.6%	2.3%	0.8%	
Walpole						
N	11	116	7	1	-	135
% per site	8.2%	85.9%	5.2%	0.7%	-	
Longwoods						
N	5	121	5	4	-	134
% per site	<u>3.7%</u>	<u>89.6%</u>	<u>3.7%</u>	<u>3.0%</u>	<u>-</u>	
Total						
N	108	621	53	18	5	805
% across sites	13.4%	77.1%	6.6%	2.4%	0.6%	100%
	=====	=====	=====	=====	=====	=====

Note: Sites differ significantly; chi-square (df = 25) = 172, p < .001.

TABLE K-4

Q3 - Composition of Household

Site	Mother Present	Father Present	Stepparent Present	Grandparent or Other Relative Present	Unrelated Other Present
Windsor					
N	128	97	8	12	7
% of households	94.8%	71.9%	5.9%	8.8%	5.2%
Toronto					
N	124	70	3	15	8
% of households	92.5%	52.2%	2.2%	11.2%	6.0%
Scarborough					
N	131	122	3	13	3
% of households	97.8%	91.1%	2.2%	9.7%	2.2%
Etobicoke					
N	131	126	-	21	4
% of households	99.2%	95.5%	-	15.9%	3.0%
Walpole					
N	133	120	2	7	2
% of households	98.5%	88.9%	1.5%	5.2%	1.5%
Longwoods					
N	132	125	3	8	4
% of households	<u>97.8%</u>	<u>92.6%</u>	<u>2.2%</u>	<u>5.9%</u>	<u>3.0%</u>
Total					
N	779	660	19	76	28
% of households	<u>96.8%</u>	<u>82.0%</u>	<u>2.8%</u>	<u>10.9%</u>	<u>4.1%</u>

Note: Sites differ significantly on number of households with father present tested;
chi-square (df = 5) = 121.8, p < .001.

TABLE K-5

Q4 - Age of Children Living at Home

Site	Aged Less Than 1 Year	Aged 1 - 3 Years	Aged 4 - 6 Years	Aged 7 - 12 Years	Aged 13 - 18 Years	Aged Over 18 Years
Windsor N	18	54	134	50	14	1
Toronto N	8	58	126	43	9	2
Scarborough N	14	66	116	38	11	1
Etobicoke N	18	60	132	57	7	3
Walpole N	13	55	133	72	12	2
Longwoods N	<u>12</u>	<u>48</u>	<u>124</u>	<u>66</u>	<u>16</u>	<u>2</u>
Total N	83	287	765	326	69	11
	==	==	==	==	==	==

Note: Sites differ significantly; chi-square (df = 25) = 35.0, p < .001.

TABLE K-6

Q6 - Leadworker Status of Father's Occupation* by Site

Site	Tested for Lead on Job	Worker in Lead Industry	Scrap Metal, Electrician, Plumber, Roofers	Painters	Mechanics, Gas Station Attendants	Taxi, Bus Drivers	Total % of Site
Windsor							
N	4	-	2	2	1	8	17
% per site	4.1%	-	2.1%	2.1%	1.0%	8.2%	17.4%
Toronto							
N	3	-	3	2	1	8	17
% per site	4.3%	-	4.3%	2.9%	1.4%	11.4%	24.3%
Scarborough							
N	1	-	6	1	3	6	17
% per site	0.8%	-	4.9%	0.8%	2.5%	4.9%	13.9%
Etobicoke							
N	-	-	-	1	2	9	12
% per site	-	-	-	0.8%	1.6%	7.1%	9.5%
Walpole							
N	5	3	4	1	10	7	30
% per site	4.2%	2.5%	3.3%	0.8%	8.3%	5.8%	24.9%
Longwoods							
N	4	1	11	7	12	12	47
% per site	3.2%	0.8%	8.8%	5.6%	9.6%	9.6%	37.6%
Total							
N	17	4	26	14	29	50	140
% across sites	2.6%	0.6%	3.9%	2.1%	4.4%	7.6%	21.1%

* Occupational coding categories adopted from Toronto Department of Public Health

Note 1: Percentages are based on the total number of fathers at home, both employed and unemployed; total number = 660, 547 not exposed to lead at workplace.

Note 2: Sites differ significantly; chi-square (df = 25) = 62, p < .001.

TABLE K-7

Q7 - Leadworker Status of Mother's Occupation* by Site

Site	Tested for Lead on Job	Worker in Lead Industry	Scrap Metal, Electrician, Plumber, Roofer	Painters	Mechanics, Gas Station Attendants	Taxi, Bus Drivers	Total % of Mothers per Site
Windsor							
N	-	-	-	-	-	1	1
% per site	-	-	-	-	-	0.8%	0.8%
Toronto							
N	1	-	-	-	-	2	3
% per site	0.8%	-	-	-	-	1.6%	2.4%
Scarborough							
N	-	-	-	-	1	3	4
% per site	-	-	-	-	0.8%	2.3%	3.1%
Etobicoke							
N	-	-	-	-	1	3	4
% per site	-	-	-	-	0.8%	2.3%	3.1%
Walpole							
N	-	-	-	-	-	-	-
% per site	-	-	-	-	-	-	-
Longwoods							
N	-	-	-	-	-	1	1
% per site	-	-	-	-	-	0.8%	0.8%
Total							
N	1	-	-	-	2	10	13
% across sites	0.1%	-	-	-	0.3%	1.3%	1.7%

* Occupational coding categories adopted from Toronto Department of Public Health

Note: Percentages are based on the total number of mothers at home, both employed and unemployed; total number = 779, 776 not exposed to lead at workplace.

TABLE K-8

Q8 and Q9 - Leadworker Status of Other Adults' Occupation
in Household by Site

Site	Other Adult #1		Other Adult #2	
	Tested for Lead on Job	Taxi, Bus Driver	Tested for Lead on Job	Taxi, Bus Driver
Windsor				
N	-	2	-	-
% per site				
Toronto				
N	-	1	-	-
% per site				
Scarborough				
N	-	-	-	-
% per site				
Etobicoke				
N	1	1	-	-
% per site				
Walpole				
N	-	-	-	-
% per site				
Longwoods				
N	-	1	-	1
% per site				
Total				
N	1	5	-	1
% across sites				

TABLE K-9

Socioeconomic Status* by Site

Site	0	1	2	3	4	5	6	7	Total
Windsor									
N	27	0	44	15	19	15	6	5	131
% per site	20.6%	0	33.6%	11.5%	14.5%	11.5%	4.6%	3.8%	
Toronto									
N	46	0	23	17	14	10	17	1	128
% per site	35.9%	0	18.0%	13.3%	10.9%	7.8%	13.3%	0.8%	
Scarborough									
N	3	0	18	24	35	23	25	5	133
% per site	2.3%	0	13.5%	18.1%	26.3%	17.3%	18.8%	3.8%	
Etobicoke									
N	0	0	19	13	21	31	36	10	130
% per site	0	0	14.6%	10.0%	16.2%	23.8%	27.7%	7.7%	
Walpole									
N	9	0	56	25	20	15	5	2	132
% per site	6.8%	0	42.4%	18.9%	15.2%	11.4%	3.8%	1.5%	
Longwoods									
N	4	0	37	24	26	24	14	3	132
% per site	3.0%	0	28.0%	18.2%	19.7%	18.2%	10.6%	2.3%	
Total									
N	89	0	197	118	135	118	103	26	796
% across sites	11.2%	0	24.7%	14.8%	17.0%	14.8%	12.9%	3.3%	100%

Note 1: Sites differ significantly; chi-square (df = 30) = 234, p < .001.

Note 2: Representative occupations of categories used for assigning socioeconomic status included: 0) unemployed or no occupation listed (other than housewife) for any adult in household; 1) fishers and forestry workers (no parents in this category); 2) labourers and drivers; 3) semi-skilled trademen and factory workers; 4) skilled tradesmen and clerical workers; 5) teachers and middle managers; 6) professionals and senior managers; 7) judges and physicians.

Note 3: Missing data = 18.

TABLE K-10

Type of Residence by Site

<u>Site</u>	<u>House</u>	<u>Apartment</u>
Windsor		
N	122	13
% per site	90.4%	9.6%
Toronto		
N	28	106
% per site	20.9%	79.1%
Scarborough		
N	89	45
% per site	66.4%	33.6%
Etobicoke		
N	98	34
% per site	74.2%	25.8%
Walpole		
N	122	13
% per site	90.4%	9.6%
Longwoods		
N	131	4
% per site	<u>97.0%</u>	<u>3.0%</u>
Total		
N	590	215
% across sites	73.3%	26.7%
	=====	=====

Note: Sites differ significantly; chi-square (df = 5) - 269, p < .001.

TABLE K-11

Age of Residence

Site	1 - 15	16 - 30	31 - 45	46 - 60	61 - 75	Over 75	Total
Windsor							
N	17	53	28	20	5	10	133
% per site	12.8%	39.8%	21.1%	15.0%	3.8%	7.5%	100%
Toronto							
N	35	54	3	4	2	29	127
% per site	27.6%	42.5%	2.4%	3.1%	1.6%	22.8%	100%
Scarborough							
N	13	56	50	4	10	-	133
% per site	9.8%	42.1%	37.6%	3.0%	7.5%	-	100%
Etobicoke							
N	62	60	7	1	-	1	131
% per site	47.3%	45.8%	5.3%	0.8%	-	0.8%	100%
Walpole							
N	51	20	9	19	10	26	135
% per site	37.8%	14.8%	6.7%	14.1%	7.4%	19.2%	100%
Longwoods							
N	47	29	13	7	7	32	135
% per site	<u>34.8%</u>	<u>21.5%</u>	<u>9.6%</u>	<u>5.2%</u>	<u>5.2%</u>	<u>23.7%</u>	<u>100%</u>
Total							
N	225	272	110	55	34	98	794
% across sites	28.3%	34.3%	13.9%	6.9%	4.3%	12.3%	100%
	=====	=====	=====	=====	=====	=====	=====

Note: Sites differ significantly; chi-square (df = 25) = 309.8, p < .001.

TABLE K-12
Q12 - Type of Construction

Site	Brick	Wood	Stone	Aluminum Siding	Stucco	Insul- Brick	Other
Windsor							
N	72	8	3	17	3	9	22
% per site	53.7%	6.0%	2.2%	12.7%	2.2%	6.7%	16.4%
Toronto							
N	127	1	2	2	-	-	1
% per site	95.5%	0.8%	1.5%	1.5%	-	-	0.8%
Scarborough							
N	94	15	1	10	9	1	3
% per site	70.7%	1.9%	0.8%	7.5%	6.8%	0.8%	2.3%
Etobicoke							
N	126	-	1	2	1	-	2
% per site	95.5%	-	0.8%	1.5%	0.8%	-	1.5%
Walpole							
N	63	18	2	27	3	7	14
% per site	47.0%	13.4%	1.5%	20.1%	2.2%	5.2%	10.5%
Longwoods							
N	76	14	-	26	4	4	11
% per site	<u>56.3%</u>	<u>10.4%</u>	<u>-</u>	<u>19.3%</u>	<u>3.0%</u>	<u>3.0%</u>	<u>8.2%</u>
Total							
N	558	56	9	84	20	21	53
% across sites	69.7%	7.0%	1.1%	10.5%	2.5%	2.3%	6.6%

Missing = 4

Note: Sites differ significantly; chi-square (df = 30) = 197.3, p <.001.

TABLE K-13

Q13 - Exterior of Residence Painted by Site

Site	Yes	No	Trim Only	Total
Windsor				
N	20	28	86	134
% per site	14.9%	20.9%	64.2%	100%
Toronto				
N	13	25	94	132
% per site	9.9%	18.9%	71.2%	100%
Scarborough				
N	47	15	71	133
% per site	35.3%	11.3%	53.4%	100%
Etobicoke				
N	35	14	83	132
% per site	26.5%	10.6%	62.9%	100%
Walpole				
N	43	25	66	134
% per site	32.1%	18.7%	49.3%	100%
Longwoods				
N	50	17	68	135
% per site	<u>37.0%</u>	<u>12.6%</u>	<u>50.4%</u>	<u>100%</u>
Total				
N	208	124	468	800
% across sites	26.0%	15.5%	58.5%	100%
Missing = 5				

Note: Sites differ significantly; chi-square (df = 10) - 49.9, p < .001.

TABLE K-14

Q15 - Year Residence Last Painted by Site

Site	1974 or Before	1975 - 1979	1980 - 1984	Total
Windsor				
N	1	9	66	76
% per site	1.3%	11.8%	86.8%	100%
Toronto				
N	-	5	47	52
% per site	-	9.6%	90.4%	100%
Scarborough				
N	5	15	74	95
% per site	5.3%	15.8%	77.9%	100%
Etobicoke				
N	4	6	65	75
% per site	5.3%	8.0%	86.7%	100%
Walpole				
N	1	15	56	72
% per site	1.4%	20.8%	77.8%	100%
Longwoods				
N	8	13	72	95
% per site	<u>8.4%</u>	<u>13.7%</u>	<u>75.8%</u>	<u>100%</u>
Total				
N	20	63	241	465
% across sites	<u>4.3%</u>	<u>13.6%</u>	<u>51.8%</u>	<u>100%</u>
Missing = 340				

TABLE K-15

Q16 & Q17 - Residences Built on Landfill
with Added Topsoil, with Bare Patches or with Gardens

Site	Built on Landfill	Topsoil Added	Bare Patches	Gardens
Windsor				
N	10	25	83	43
% per site	7.5%	18.7%	61.5%	32.1%
Toronto				
N	6	51	91	25
% per site	4.5%	38.1%	67.9%	18.8%
Scarborough				
N	5	58	95	37
% per site	3.7%	43.3%	70.9%	27.8%
Etobicoke				
N	-	74	87	53
% per site	-	56.1%	65.9%	40.1%
Walpole				
N	6	42	92	61
% per site	4.4%	31.1%	68.2%	45.2%
Longwoods				
N	2	51	98	99
% per site	<u>1.5%</u>	<u>37.8%</u>	<u>72.6%</u>	<u>73.3%</u>
Total				
N	29	301	546	318
% across sites	<u>3.6%</u>	<u>37.4%</u>	<u>67.8%</u>	<u>39.5%</u>

Note 1: Sites differ significantly on landfill; chi-square (df = 5) = 48.0, p < .001.

Note 2: Sites differ significantly on topsoil; chi-square (df = 5) = 32.8, p < .001.

Note 3: Sites differ significantly on gardens; chi-square (df = 5) = 100.7, p < .001.

TABLE K-16

Q22 - Type of Heating System by Site

Site	Oil Forced Air	Oil - Hot Water Radiators	Gas Forced Air	Gas - Hot Water Radiators	Hydro	Wood Stove	Hot Water Radiators	Total
Windsor								
N	2	1	108	13	11	-	-	135
% per site	1.5%	0.7%	80.0%	9.6%	8.2%	-	-	100%
Toronto								
N	3	8	21	72	27	-	3	134
% per site	2.2%	6.0%	15.7%	53.7%	20.2%	-	2.2%	100%
Scarborough								
N	15	32	45	23	14	-	5	134
% per site	11.2%	23.9%	33.6%	17.2%	10.5%	-	3.7%	100%
Etobicoke								
N	11	11	80	7	11	-	12	132
% per site	8.3%	8.3%	60.6%	5.3%	8.3%	-	9.1%	100%
Walpole								
N	19	24	58	9	12	13	-	135
% per site	14.1%	17.8%	43.0%	6.7%	8.9%	9.6%	-	100%
Longwoods								
N	43	16	44	5	15	11	1	135
% per site	<u>31.9%</u>	<u>11.9%</u>	<u>32.6%</u>	<u>3.7%</u>	<u>11.1%</u>	<u>8.2%</u>	<u>0.7%</u>	<u>100%</u>
Total								
N	93	92	356	129	90	24	21	805
% across sites	11.6%	11.4%	44.2%	16.0%	11.2%	3.0%	2.6%	100%
	=====	=====	=====	=====	=====	=====	=====	=====

Note: Sites differ significantly; chi-square (df = 30) = 433.2, p < .001.

TABLE K-17

Q23 - Open Fireplace, Usage and Burning of Coloured Inks by Site

Site	Open Fireplace Present	Used Daily	Used Weekly	Used Monthly	Used Never	Coloured Inks Burned
Windsor						
N	16	4	6	4	2	10
% per site	11.9%					58.8%
Toronto						
N	6	1	-	3	2	-
% per site	4.5%					-
Scarborough						
N	38	9	15	8	6	14
% per site	28.4%					35.0%
Etobicoke						
N	46	1	20	14	11	16
% per site	34.9%					34.0%
Walpole						
N	25	13	5	7	-	9
% per site	18.5%					34.6%
Longwoods						
N	48	7	14	13	14	7
% per site	35.6%					15.6%
Total						
N	179	35	60	49	35	56
% across sites	22.2%					7.0%
	=====	=====	=====	=====	=====	=====

Note 1: Sites differ significantly on fireplace; chi-square (df = 5) = 61.6, p < .001.

Note 2: Sites differ significantly on frequency on use of fireplace; chi-square (df = 15) = 39.2, p < .01.

Note 3: Sites differ significantly on coloured ink; chi-square (df = 5) = 15.0, p < .01.

TABLE K-18

**Q24 & Q25 - Forced Air Heat, Air Filter,
Air Cleaner and Air Conditioner by Site**

<u>Site</u>	<u>Forced Air Heat</u>	<u>Air Filter</u>	<u>Air Cleaner</u>	<u>Air Conditioner</u>	<u>Central Air Conditioner</u>
Windsor					
N	111	101	12	84	63
% per site	82.2%	74.8%	8.9%	62.7%	4.7%
Toronto					
N	31	29	14	25	15
% per site	23.1%	21.6%	10.5%	18.7%	11.2%
Scarborough					
N	77	63	22	38	28
% per site	57.5%	47.0%	16.4%	28.4%	20.9%
Etobicoke					
N	105	103	32	91	28
% per site	79.6%	78.0%	24.2%	68.9%	21.2%
Walpole					
N	88	85	40	31	25
% per site	65.2%	63.0%	29.9%	23.0%	18.5%
Longwoods					
N	113	106	12	38	24
% per site	<u>83.7%</u>	<u>78.5%</u>	<u>8.9%</u>	<u>28.2%</u>	<u>17.8%</u>
Total					
N	525	487	132	307	183
% across sites	65.2%	60.5%	16.4%	38.2%	22.7%
	=====	=====	=====	=====	=====

Note 1: Sites differ significantly on forced air heat; chi-square (df = 5) = 163.3, p < .001.

Note 2: Sites differ significantly on air filters; chi-square (df = 10) = 217.4, p < .001.

Note 3: Sites differ significantly on air conditioners; chi-square (df = 5) = 134.3, p < .001.

TABLE K-19

Q26 - Renovations by Site

Site	<u>Renovations</u>	<u>Sandblasting, Sanding Paint</u>	<u>Removal of Walls</u>	<u>Plumbing</u>	<u>Other</u>
Windsor					
N	45	-	22	22	40
% per site	33.6%	-	16.3%	16.3%	29.6%
Toronto					
N	24	-	2	9	22
% per site	17.9%	-	1.5%	6.7%	16.2%
Scarborough					
N	62	22	33	36	17
% per site	46.3%	16.4%	24.6%	26.9%	12.7%
Etobicoke					
N	59	24	11	32	36
% per site	44.7%	18.2%	8.3%	24.2%	27.3%
Walpole					
N	46	5	17	13	33
% per site	34.1%	3.7%	12.6%	9.6%	24.4%
Longwoods					
N	65	27	40	50	46
% per site	<u>48.2%</u>	<u>20.0%</u>	<u>29.6%</u>	<u>37.0%</u>	<u>34.1%</u>
Total					
N	301	78	125	162	194
% across sites	37.4%	9.7%	15.5%	20.1%	24.1%
	<u><u> </u></u>	<u><u> </u></u>	<u><u> </u></u>	<u><u> </u></u>	<u><u> </u></u>

Note 1: Sites differ on renovations; chi-square (df = 5) = 37.5, p < .001.

Note 2: Sites differ on sandblasting; chi-square (df = 5) = 59.4, p < .001.

Note 3: Sites differ on walls; chi-square (df = 5) = 56.5, p < .001.

Note 4: Sites differ on pipes; chi-square (df = 5) = 50.44, p < .001.

Note 5: Sites differ on other renovations; chi-square (df = 5) = 40.7, p < .001.

TABLE K-20

Q27 - Source of Water Supply by Site

<u>Site</u>	<u>City Water</u>	<u>Well Water</u>	<u>Other</u>
Windsor			
N	135	-	-
% per site	100.0%	-	-
Toronto			
N	134	-	-
% per site	100.0%	-	-
Scarborough			
N	134	-	-
% per site	100.0%	-	-
Etobicoke			
N	131	1	-
% per site	99.2%	0.8%	-
Walpole			
N	77	21	37
% per site	57.0%	15.6%	27.4%
Longwoods			
N	32	85	18
% per site	<u>23.7%</u>	<u>62.9%</u>	<u>13.3%</u>
Total			
N	643	106	55
% across sites	<u>79.9%</u>	<u>19.9%</u>	<u>6.8%</u>

Note: Sites differ on water supply; chi-square (df = 10) = 524.7, p < .001.

TABLE K-21

Q28a - Number of Gas Stations Within Six Blocks
(1/2 Mile) by Site

Site	0	1	2	3	4	5	6	More Than 6
Windsor								
N	3.5	40	30	13	6	8	2	1
% per site	25.9%	29.6%	22.2%	9.6%	4.4%	5.9%	1.5%	0.7%
Toronto								
N	2	15	28	23	30	19	10	7
% per site	1.5%	11.2%	20.9%	17.2%	22.4%	14.2%	7.5%	5.3%
Scarborough								
N	-	19	22	29	22	14	11	17
% per site	-	14.2%	16.4%	21.6%	16.4%	10.5%	8.2%	12.7%
Etobicoke								
N	2	22	50	25	20	8	2	3
% per site	1.5%	16.7%	37.9%	18.9%	15.2%	6.1%	1.5%	2.3%
Walpole								
N	61	25	28	15	2	4	1	-
% per site	45.2%	17.8%	20.7%	11.1%	1.5%	3.0%	0.7%	-
Longwoods								
N	86	20	15	11	3	-	-	-
% per site	63.7%							
Total								
N	186	140	6	116	83	53	26	28
% across sites	23.1%	17.4%	18.1%	14.4%	10.3%	6.6%	3.2%	3.6%

Note: Sites differ a number of gas stations; chi-square (df = 45) = 419.4, p < .001.

TABLE K-22

Q28b - Number of 4-Lane Roads Within Six Blocks
(1/2 Mile) by Site

Site	0	1	2	3	4	5	6
Windsor							
N	52	72	11	-	-	-	-
% per site	38.5%	53.3%	8.2%	-	-	-	-
Toronto							
N	8	6	17	14	43	13	33
% per site	5.6%	4.5%	12.7%	10.5%	32.1%	9.7%	24.7%
Scarborough							
N	26	43	33	17	9	4	2
% per site	19.4%	32.1%	24.6%	12.7%	6.7%	3.0%	1.5%
Etobicoke							
N	5	40	42	37	4	2	2
% per site	3.8%	30.3%	31.8%	28.0%	3.0%	1.5%	1.5%
Walpole							
N	130	5	-	-	-	-	-
% per site	96.3%	3.7%	-	-	-	-	-
Longwoods							
N	117	17	1	-	-	-	-
% per site	<u>86.7%</u>	<u>12.6%</u>	<u>0.7%</u>	-	-	-	-
Total							
N	338	183	104	68	56	19	37
% across sites	<u>42.0%</u>	<u>22.7%</u>	<u>12.9%</u>	<u>8.5%</u>	<u>7.0%</u>	<u>2.4%</u>	<u>4.4%</u>

Note: Sites differ on 4-lane roads; chi-square (df = 45) = 891.7, p < .001.

TABLE K-23

Q28c - Number of Minor Highways Within Six Blocks
(1/2 Mile) by Site

Site	0	1	2
Windsor			
N	106	28	1
% per site	78.5%	20.7%	0.7%
Toronto			
N	111	21	2
% per site	82.8%	15.7%	1.5%
Scarborough			
N	15	115	4
% per site	11.2%	85.8%	3.0%
Etobicoke			
N	129	3	-
% per site	97.7%	2.3%	-
Walpole			
N	52	72	11
% per site	38.5%	53.3%	8.2%
Longwoods			
N	69	65	1
% per site	<u>51.1%</u>	<u>48.2%</u>	<u>0.7%</u>
Total			
N	482	304	19
% across sites	59.9%	37.8%	2.4%
	=====	=====	=====

Note: Sites differ on minor highways; chi-square (df = 10) = 309.8, p < .001.

TABLE K-24

Q28d - Number of Major Highways Within Six Blocks
(1/2 Mile) by Site

Site	0	1	2	3
Windsor				
N	130	1	2	2
% per site	96.3%	0.7%	1.5%	1.5%
Toronto				
N	41	63	30	-
% per site	30.6%	47.0%	22.4%	-
Scarborough				
N	134	-	-	-
% per site	100.0%	-	-	-
Etobicoke				
N	35	87	10	-
% per site	26.5%	65.9%	7.6%	-
Walpole				
N	118	16	1	-
% per site	87.4%	11.9%	0.7%	-
Longwoods				
N	63	68	4	-
% per site	<u>46.7%</u>	<u>50.4%</u>	<u>3.0%</u>	<u>-</u>
Total				
N	521	235	47	2
% across sites	<u>64.7%</u>	<u>29.2%</u>	<u>5.8%</u>	<u>0.3%</u>

Note: Sites differ on major highways; chi-square (df = 15) = 395.3, p < .001.

TABLE K-25

Q28e - Number of Major Industries Within Six Blocks
(1/2 Mile) by Site

Site	0	1	2	3	4	5	6	7	8	9
Windsor										
N	77	27	20	3	1	5	-	-	-	-
% per site	57.0%	20.0%	14.8%	2.2%	0.7%	3.7%	-	-	-	1.5%
Toronto										
N	69	15	12	4	14	7	10	-	1	2
% per site	51.5%	11.2%	9.0%	3.0%	10.5%	5.2%	7.5%	-	0.7%	1.5%
Scarborough										
N	104	13	12	2	2	-	-	-	1	-
% per site	77.6%	9.7%	9.0%	1.5%	1.5%	-	-	-	0.8%	-
Etobicoke										
N	129	2	2	-	-	-	-	-	-	-
% per site	97.7%	1.5%	0.8%	-	-	-	-	-	-	-
Walpole										
N	99	17	9	6	4	-	-	-	-	-
% per site	73.3%	12.6%	6.7%	4.4%	3.0%	-	-	-	-	-
Longwoods										
N	107	12	12	3	1	-	-	-	-	-
% per site	79.3%	8.9%	8.9%	2.2%	0.7%	-	-	-	-	-
Total										
N	585	86	66	18	22	12	10	-	2	4
% across sites	72.7%	10.7%	8.2%	2.2%	2.7%	1.5%	1.2%	-	0.3%	0.5%

Note: Sites differ on major industries; chi-square (df = 40) = 190.6, p < .001.

TABLE K-26

Q29a - Number of Gas Stations Within One Block by Site

Site	0	1	2	3	4	5
Windsor						
N	108	18	9	-	-	-
% per site	80.0%	13.3%	6.7%	-	-	-
Toronto						
N	25	71	34	4	-	-
% per site	18.7%	53.0%	25.4%	3.0%	-	-
Scarborough						
N	81	31	16	4	1	1
% per site	60.5%	23.1%	11.9%	3.0%	0.8%	0.8%
Etobicoke						
N	88	40	3	-	1	-
% per site	66.7%	30.3%	2.3%	-	0.8%	-
Walpole						
N	10	21	4	-	-	-
% per site	81.5%	15.6%	3.0%	-	-	-
Longwoods						
N	20	11	3	-	-	1
% per site	88.9%	8.2%	2.2%	-	-	0.7%
Total						
N	532	192	69	8	2	2
% across sites	66.1%	23.9%	8.6%	1.0%	0.3%	0.3%
	=====	=====	=====	=====	=====	=====

Note: Sites differ on gas stations; chi-square (df = 30) = 230.1, p < .001.

TABLE K-27

Q29b - Number of 4-Lane Roads Within One Block by Site

Site	0	1	2	3	4
Windsor					
N	109	26	-	-	-
% per site	80.7%	19.3%	-	-	-
Toronto					
N	19	27	54	19	15
% per site	14.2%	20.2%	40.3%	14.2%	11.2%
Scarborough					
N	95	27	12	-	-
% per site	70.9%	20.2%	9.0%	-	-
Etobicoke					
N	62	52	17	1	-
% per site	47.0%	39.4%	12.9%	0.8%	-
Walpole					
N	133	2	-	-	-
% per site	98.5%	1.5%	-	-	-
Longwoods					
N	125	10	-	-	-
% per site	<u>92.6%</u>	<u>7.4%</u>	-	-	-
Total					
N	543	144	83	20	15
% across sites	67.5%	17.9%	10.3%	2.5%	1.9%
	=====	=====	=====	=====	=====

Note: Sites differ on 4-lane roads; chi-square (df = 20) = 479.8, p < .001.

TABLE K-28

Q29c - Number of Minor Highways Within One Block by Site

Site	0	1	2
Windsor			
N	126	8	1
% per site	93.3%	5.9%	0.7%
Toronto			
N	131	3	-
% per site	97.8%	2.2%	-
Scarborough			
N	79	55	-
% per site	59.0%	41.0%	-
Etobicoke			
N	132	-	-
% per site	100.0%	-	-
Walpole			
N	90	42	3
% per site	66.7%	31.1%	2.2%
Longwoods			
N	98	37	-
% per site	72.6%	27.4%	-
Total			
N	656	145	4
% across sites	81.5%	18.0%	0.5%

Note: Sites differ on minor highways; chi-square (df = 10) = 149.6, p < .001.

TABLE K-29

Q29d - Number of Major Highways Within One Block by Site

<u>Site</u>	<u>0</u>	<u>1</u>	<u>2</u>
Windsor			
N	135	-	-
% per site	100.0%	-	-
Toronto			
N	112	21	1
% per site	83.6%	15.7%	0.8%
Scarborough			
N	134	-	-
% per site	100.0%	-	-
Etobicoke			
N	95	37	-
% per site	72.0%	28.0%	-
Walpole			
N	126	9	-
% per site	93.3%	6.7%	-
Longwoods			
N	101	34	-
% per site	<u>74.8%</u>	<u>25.2%</u>	<u>-</u>
Total			
N	703	101	1
% across sites	<u>87.3%</u>	<u>12.6%</u>	<u>0.1%</u>

Note: Sites differ on major highways; chi-square (df = 10) = 97.5, p <.001.

TABLE K-30

Q29e - Number of Major Industries Within One Block by Site

Site	0	1	2	3	4	5	6
Windsor							
N	117	9	3	2	3	1	-
% per site	86.7%	6.7%	2.2%	1.5%	2.2%	0.7%	-
Toronto							
N	112	15	5	2	-	-	-
% per site	83.6%	11.2%	0.6%	1.5%	-	-	-
Scarborough							
N	131	-	2	-	-	-	1
% per site	97.8%	-	1.5%	-	-	-	0.8%
Etobicoke							
N	132	-	-	-	-	-	-
% per site	100.0%	-	-	-	-	-	-
Walpole							
N	121	13	1	-	-	-	-
% per site	89.6%	9.6%	0.7%	-	-	-	-
Longwoods							
N	125	8	2	-	-	-	-
% per site	92.6%	5.9%	1.5%	-	-	-	-
Total							
N	738	45	13	4	3	1	1
% across sites	91.7%	5.6%	1.6%	0.5%	0.4%	0.1%	0.1%

Note: Sites differ on major industries; chi-square (df = 30) = 70.1, p < .001.

TABLE K-31

Q30 - Type of Road in Front of House by Site

Site	Highway	Major Commercial	Some Commercial	Residential	Rural
Windsor					
N	1	4	15	115	-
% per site	0.7%	3.0%	11.1%	85.2%	-
Toronto					
N	-	17	77	40	-
% per site	-	12.7%	57.5%	29.9%	-
Scarborough					
N	-	18	8	108	-
% per site	-	13.4%	6.0%	80.6%	-
Etobicoke					
N	-	2	21	109	-
% per site	-	1.5%	15.9%	82.6%	-
Walpole					
N	15	1	6	50	63
% per site	11.1%	0.7%	4.4%	37.0%	46.7%
Longwoods					
N	34	-	2	51	48
% per site	<u>25.2%</u>	<u>-</u>	<u>1.5%</u>	<u>37.8%</u>	<u>35.6%</u>
Total					
N	50	42	129	473	111
% across sites	6.2%	5.2%	16.0%	58.8%	13.8%
	=====	=====	=====	=====	=====

Note: Sites differ on type of road by house; chi-square (df = 20) = 645.0, p < .001.

TABLE K-32

Q73 - Home Hobbies by Site

Site	Soldering	Painting	Stained Glass	Pottery Glazing	Auto Repairing	Furniture Refinishing
Windsor						
N	23	52	-	7	35	21
% per site	17.0%	38.5%	-	5.2%	25.9%	15.6%
Toronto						
N	6	35	1	2	13	9
% per site	4.5%	26.1%	0.8%	1.5%	9.7%	6.7%
Scarborough						
N	32	52	5	4	33	46
% per site	23.9%	38.8%	3.7%	3.0%	24.6%	34.3%
Etobicoke						
N	33	29	2	10	36	20
% per site	25.0%	22.0%	1.5%	7.6%	27.3%	15.2%
Walpole						
N	24	14	2	2	29	16
% per site	17.8%	10.4%	1.5%	1.5%	21.5%	11.9%
Longwoods						
N	32	15	5	3	23	36
% per site	<u>23.7%</u>	<u>11.1%</u>	<u>3.7%</u>	<u>2.2%</u>	<u>17.0%</u>	<u>26.7%</u>
Total						
N	150	197	15	28	169	148
% across sites	<u>18.6%</u>	<u>24.5%</u>	<u>1.8%</u>	<u>3.5%</u>	<u>21.0%</u>	<u>18.4%</u>

Note 1: Sites differ significantly on soldering; chi-square (df = 5) = 25.8, p < .001.

Note 2: Sites differ significantly on painting; chi-square (df = 5) = 56.7, p < .001.

Note 3: Sites differ significantly on pottery; chi-square (df = 5) = 11.6, p < .01.

Note 4: Sites differ significantly on auto repairing; chi-square (df = 5) = 17.2, p < .01.

Note 5: Sites differ significantly on furniture refinishing; chi-square (df = 5) = 46.3, p < .001.

TABLE K-33

Q74 - Frequency of Cooking With Garden Vegetables by Site

Site	Cook With Garden Vegetables	Daily	Summer Weekly	Monthly	Daily	Winter Weekly	Monthly
Windsor							
N	43	21	20	2	-	12	7
% per site	31.9%						
Toronto							
N	10	4	3	3	2	-	-
% per site	7.5%						
Scarborough							
N	41	18	19	4	2	8	8
% per site	30.6%						
Etobicoke							
N	49	20	9	11	1	12	5
% per site	37.1%						
Walpole							
N	59	34	22	3	17	22	2
% per site	43.7%						
Longwoods							
N	100	83	16	1	42	35	16
% per site	74.6%						
Total							
N	302	180	89	24	64	89	38
% across sites	37.6%	22.4%	11.1%	2.9%	7.9%	11.1%	4.7%

Note 1: Sites differ significantly on cooking with garden vegetables; chi-square (df = 5) = 134.9, p <.001.

Note 2: Sites differ significantly on frequency of cooking with garden vegetables in summer; chi-square (df = 10) = 58.2, p <.001.

Note 3: Sites differ significantly on frequency of cooking with vegetables during winter; chi-square (df = 10) = 38.9, p <.01.

TABLE K-34

Q75 - Frequency of Use of Canned Milk by Site

Site	Use Canned Milk	Daily	Weekly	Monthly
Windsor				
N	14	5	3	6
% per site	10.5%			
Toronto				
N	35	19	10	6
% per site	26.1%			
Scarborough				
N	19	5	7	7
% per site	14.2%			
Etobicoke				
N	36	9	2	25
% per site	27.3%			
Walpole				
N	19	6	6	7
% per site	14.1%			
Longwoods				
N	20	9	2	9
% per site	14.8%			
Total				
N	143	53	30	60
% across sites	17.8%	6.6%	3.7%	7.5%

Note: Sites differ significantly on use of canned milk; chi-square (df = 5) = 24.4, p < .001.

TABLE K-35

Q76 - Presence and Age of Electric Kettle by Site

Site	Electric Kettle Present	Kettle Age Less Than 5 Years	Kettle Age 5-10 Years	Kettle Age More Than 10 Years
Windsor N	71	52	14	5
% per site	52.6%			
Toronto N	55	44	11	-
% per site	41.0%			
Scarborough N	80	62	15	3
% per site	59.7%			
Etobicoke N	63	42	15	6
% per site	47.7%			
Walpole N	71	41	23	7
% per site	52.6%			
Longwoods N	77	43	28	6
% per site	57.0%			
Total N	417	284	106	27
% across sites of total with kettles	51.8%	68.1%	25.4%	6.5%

Note 1: Sites differ significantly on use of electric kettles; chi-square
(df = 5) = 13.5, p < .01.

TABLE K-36

Q77 - Number and Types of Pets by Site

Site	# of Pets Present	Number of Dogs		Number of Cats	
		One	More Than One	One	More Than One
Windsor					
N	81	21	9	52	8
% per site	60.5%				
Toronto					
N	52	20	13	24	-
% per site	38.8%				
Scarborough					
N	74	17	8	34	2
% per site	55.2%				
Etobicoke					
N	44	13	3	19	2
% per site	33.3%				
Walpole					
N	83	41	12	43	10
% per site	61.5%				
Longwoods					
N	93	30	17	51	24
% per site	69.4%	—	—	—	—
Total					
N	427	142	62	223	46
% across sites	53.2%				
	==	==	==	==	==

Note: Sites differ significantly by presence of pets; chi-square (df = 5) = 52.3, p <.001.

TABLE K-37

Q78 - Pica by Site

<u>Site</u>	<u>Number Reporting Pica</u>
Windsor	
N	53
% per site	39.3%
Toronto	
N	49
% per site	36.6%
Scarborough	
N	60
% per site	44.8%
Etobicoke	
N	64
% per site	48.5%
Walpole	
N	54
% per site	40.0%
Longwoods	
N	19
% per site	<u>14.1%</u>
Total	
N	299
% across sites	<u>37.1%</u>

Note: Sites differ significantly; chi-square (df = 5) = 32.4, $p < .01$.

TABLE K-38

Q81 - Kitchen Inspection

<u>Site</u>	<u>Inspected</u>	<u>Inspection Refused</u>	<u>Total</u>
Windsor			
N	119	16	135
% per site	88.2%	11.8%	100%
Toronto			
N	133	1	134
% per site	99.2%	0.8%	100%
Scarborough			
N	133	1	134
% per site	99.2%	0.8%	100%
Etobicoke			
N	124	8	132
% per site	93.9%	6.1%	100%
Walpole			
N	130	5	135
% per site	96.3%	3.7%	100%
Longwoods			
N	131	4	135
% per site	<u>97.0%</u>	<u>3.0%</u>	<u>100%</u>
Total			
N	770	35	805
% across sites	<u>95.6%</u>	<u>4.4%</u>	<u>100%</u>

Note: Sites differ significantly; chi-square (df = 5) = 28.4, p < .001.

TABLE K-39

Q81 - Types of Pipes in Kitchen by Site

Site	Galvanized Iron	Copper	Lead	Plastic	Combination Without Lead	Combination With Lead
Windsor						
N	4	69	-	29	30	3
% per site	3.0%	51.1%	-	21.5%	22.2%	2.2%
Toronto						
N	10	75	-	4	44	1
% per site	7.5%	55.9%	-	3.0%	32.8%	0.8%
Scarborough						
N	4	54	-	1	56	19
% per site	3.0%	40.3%	-	0.7%	41.0%	14.2%
Etobicoke						
N	-	121	-	-	11	-
% per site	-	91.7%	-	-	8.3%	-
Walpole						
N	1	20	8	22	78	6
% per site	0.8%	15.0%	6.0%	16.3%	57.8%	4.4%
Longwoods						
N	5	13	-	24	23	70
% per site	<u>3.7%</u>	<u>9.6%</u>	<u>-</u>	<u>17.8%</u>	<u>17.0%</u>	<u>51.9%</u>
Total						
N	24	352	8	80	242	99
% across sites	3.0%	43.9%	1.0%	10.0%	30.1%	12.3%
	=====	=====	=====	=====	=====	=====

Note: Sites differ significantly; chi-square (df = 25) = 540.7, $p < .001$.

TABLE K-40
Q83 - Bathroom Inspection

<u>Site</u>	<u>Inspected</u>	<u>Inspection Refused</u>	<u>Total</u>
Windsor			
N	115	20	135
% per site	85.2%	14.8%	100%
Toronto			
N	131	3	134
% per site	97.8%	2.2%	100%
Scarborough			
N	133	1	134
% per site	99.2%	0.8%	100%
Etobicoke			
N	120	12	132
% per site	90.9%	9.1%	100%
Walpole			
N	131	4	135
% per site	97.0%	3.0%	100%
Longwoods			
N	131	4	135
% per site	<u>97.0%</u>	<u>3.0%</u>	<u>100%</u>
Total			
N	761	44	805
% across sites	94.5%	5.5%	100%
	=====	=====	=====

Note: Sites differ significantly; chi-square (df = 10) = 44.8, p <.001.

TABLE K-41

Q84 - Bathroom Pipes

Site	Galvanized Iron	Copper	Lead	Plastic	Comb. Without Lead	Comb. With Lead	Total
Windsor							
N	10	67	1	21	35	-	134
% per site	7.5%	50.0%	0.7%	15.7%	26.1%	-	100%
Toronto							
N	82	21	-	2	27	-	132
% per site	62.1%	16.0%	-	1.5%	20.4%	-	100%
Scarborough							
N	41	17	-	2	68	5	133
% per site	30.8%	12.8%	-	1.5%	51.1%	3.8%	100%
Etobicoke							
N	8	110	-	-	14	-	132
% per site	6.1%	83.3%	-	-	10.6%	-	100%
Walpole							
N	33	13	4	19	62	2	133
% per site	24.8%	9.8%	3.0%	14.3%	46.6%	1.5%	100%
Longwoods							
N	18	12	-	23	21	60	134
% per site	<u>13.4%</u>	<u>8.9%</u>	<u>-</u>	<u>17.2%</u>	<u>15.7%</u>	<u>44.8%</u>	<u>100%</u>
Total							
N	192	240	5	67	227	67	798
% across sites	24.1%	30.1%	0.6%	8.4%	28.4%	8.4%	100%
	=====	=====	=====	=====	=====	=====	=====

Note: Sites differ significantly; chi-square (df = 25) = 707.7, p < .001.

TABLE K-42
Q85 - Basement Inspection

<u>Site</u>	<u>Inspected</u>	<u>Inspection Refused</u>	<u>Total</u>
Windsor			
N	77	58	135
% per site	57.0%	43.0%	100%
Toronto			
N	24	110	134
% per site	17.9%	82.1%	100%
Scarborough			
N	91	43	134
% per site	67.9%	32.1%	100%
Etobicoke			
N	88	44	132
% per site	66.7%	33.3%	100%
Walpole			
N	94	41	135
% per site	69.6%	30.4%	100%
Longwoods			
N	127	8	135
% per site	<u>94.1%</u>	<u>5.9%</u>	<u>100%</u>
Total			
N	501	304	805
% across sites	<u>62.2%</u>	<u>37.8%</u>	<u>100%</u>

Note: Sites differ significantly; chi-square (df = 10) = 258.2, p < .001.

TABLE K-43

Q86 - Basement Pipes

Site	Galvanized Iron	Copper	Lead	Plastic	Comb. Without Lead	Comb. With Lead	Total
Windsor							
N	4	75	-	2	34	2	117
% per site	3.4%	64.1%	-	1.7%	29.1%	1.7%	100%
Toronto							
N	36	12	-	-	7	3	58
% per site	62.1%	20.7%	-	-	12.1%	5.1%	100%
Scarborough							
N	1	28	1	-	37	24	91
% per site	1.1%	30.8%	1.1%	-	40.6%	26.4%	100%
Etobicoke							
N	-	89	-	-	8	2	99
% per site	-	89.9%	-	-	8.1%	2.0%	100%
Walpole							
N	3	35	4	6	49	4	101
% per site	3.0%	34.6%	4.0%	5.9%	48.5%	4.0%	100%
Longwoods							
N	2	53	-	1	8	69	133
% per site	<u>1.5%</u>	<u>39.9%</u>	<u>-</u>	<u>0.7%</u>	<u>6.0%</u>	<u>51.9%</u>	<u>100%</u>
Total							
N	46	292	5	9	143	104	599
% across sites	7.7%	48.7%	0.8%	1.5%	23.9%	17.4%	100%

Note: Sites differ significantly; chi-square (df = 25) = 545.6, p < .001.

TABLE K-44

Q87 - Child's Room Inspected

<u>Site</u>	<u>Inspected</u>	<u>Inspection Refused</u>	<u>Total</u>
Windsor			
N	113	22	135
% per site	83.7%	16.3%	100%
Toronto			
N	132	2	134
% per site	98.5%	1.5%	100%
Scarborough			
N	131	3	134
% per site	97.8%	2.2%	100%
Etobicoke			
N	120	12	132
% per site	90.9%	9.1%	100%
Walpole			
N	129	6	135
% per site	95.6%	4.4%	100%
Longwoods			
N	131	4	135
% per site	<u>97.0%</u>	<u>3.0%</u>	<u>100%</u>
Total			
N	756	49	805
% across sites	<u>93.9%</u>	<u>6.1%</u>	<u>100%</u>

Note: Sites differ significantly; chi-square (df =) = 38.1, p < .001.

TABLE K-45

Q88a - Child's Room - Flooring

<u>Site</u>	<u>Broadloom</u>	<u>Bare Hardwood</u>	<u>Area Rugs</u>	<u>Linoleum</u>	<u>Other</u>	<u>Total</u>
Windsor						
N	89	23	8	15	-	135
% per site	66.0%	17.0%	5.9%	11.1%	-	100%
Toronto						
N	35	25	31	43	-	134
% per site	26.1%	18.7%	23.1%	32.1%	-	100%
Scarborough						
N	77	25	27	3	-	132
% per site	58.3%	18.9%	20.5%	2.3%	-	100%
Etobicoke						
N	88	11	33	-	-	132
% per site	66.7%	8.3%	25.0%	-	-	100%
Walpole						
N	101	8	8	13	1	131
% per site	77.1%	6.1%	6.1%	9.9%	0.8%	100%
Longwoods						
N	101	16	7	11	-	135
% per site	<u>74.8%</u>	<u>11.9%</u>	<u>5.2%</u>	<u>8.1%</u>	<u>-</u>	<u>100%</u>
Total						
N	491	108	114	85	1	799
% across sites	61.5%	13.5%	14.3%	10.6%	0.1%	100%
	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>	<u> </u>

Note: Sites differ significantly; chi-square (df = 20) = 176.7, p < .001.

TABLE K-46

Q88b - Child's Room - Condition of Paint

<u>Site</u>	<u>Peeling</u>	<u>Some Peeling</u>	<u>No Peeling</u>	<u>Total</u>
Windsor				
N	5	14	116	135
% per site	3.7%	10.4%	85.9%	100%
Toronto				
N	13	20	101	134
% per site	9.7%	14.9%	75.4%	100%
Scarborough				
N	1	15	114	130
% per site	0.8%	11.5%	87.7%	100%
Etobicoke				
N	-	22	110	132
% per site	-	16.7%	83.3%	100%
Walpole				
N	4	12	115	131
% per site	3.0%	9.2%	87.8%	100%
Longwoods				
N	12	18	105	135
% per site	<u>8.9%</u>	<u>13.3%</u>	<u>77.8%</u>	<u>100%</u>
Total				
N	35	101	661	797
% across sites	<u>4.4%</u>	<u>12.7%</u>	<u>82.9%</u>	<u>100%</u>

Note: Sites differ significantly; chi-square (df = 10) = 28.7, p < .01.

TABLE K-47

Q89 - Play Area Inspection

<u>Site</u>	<u>Inspected</u>	<u>Inspection Refused</u>	<u>Total</u>
Windsor			
N	126	9	135
% per site	93.3%	6.7%	100%
Toronto			
N	133	1	134
% per site	99.3%	0.7%	100%
Scarborough			
N	134	-	134
% per site	100.0%	-	100%
Etobicoke			
N	127	5	132
% per site	96.2%	3.8%	100%
Walpole			
N	134	1	135
% per site	99.3%	0.7%	100%
Longwoods			
N	133	2	135
% per site	<u>98.5%</u>	<u>1.5%</u>	<u>100%</u>
Total			
N	787	18	805
% across sites	<u>97.8%</u>	<u>2.2%</u>	<u>100%</u>

Note: Sites differ significantly; chi-square (df = 5) = 19.8, p < .01.

TABLE K-48

Q90a - Favourite Play Area - Flooring

<u>Site</u>	<u>Broadloom</u>	<u>Bare Hardwood</u>	<u>Area Rugs</u>	<u>Linoleum</u>	<u>Other</u>	<u>Total</u>
Windsor						
N	92	12	15	12	4	135
% per site	68.1%	8.9%	11.1%	8.9%	3.0%	100%
Toronto						
N	35	18	47	32	2	134
% per site	26.1%	13.4%	35.1%	23.9%	1.5%	100%
Scarborough						
N	80	14	35	5	-	134
% per site	59.7%	10.5%	26.1%	3.7%	-	100%
Etobicoke						
N	93	3	29	5	2	132
% per site	70.4%	2.3%	22.0%	3.8%	1.5%	100%
Walpole						
N	93	12	20	3	6	134
% per site	69.4%	9.0%	14.9%	2.2%	4.5%	100%
Longwoods						
N	89	9	19	15	3	135
% per site	<u>65.9%</u>	<u>6.7%</u>	<u>14.1%</u>	<u>11.1%</u>	<u>2.2%</u>	<u>100%</u>
Total						
N	482	68	165	72	17	804
% across sites	<u>59.9%</u>	<u>8.5%</u>	<u>20.5%</u>	<u>9.0%</u>	<u>2.1%</u>	<u>100%</u>

Note: Sites differ significantly; chi-square (df = 20) = 121.5, p < .001.

TABLE K-49

Q90b - Favourite Play Area - Condition of Paint

<u>Site</u>	<u>Peeling</u>	<u>Some Peeling</u>	<u>No Peeling</u>	<u>Total</u>
Windsor				
N	3	14	118	135
% per site	2.2%	10.4%	87.4%	100%
Toronto				
N	5	26	103	134
% per site	3.7%	19.4%	76.9%	100%
Scarborough				
N	1	11	122	134
% per site	0.8%	8.2%	91.0%	100%
Etobicoke				
N	1	20	110	131
% per site	0.8%	15.3%	83.9%	100%
Walpole				
N	3	18	113	134
% per site	2.2%	13.4%	84.4%	100%
Longwoods				
N	11	26	98	135
% per site	<u>8.1%</u>	<u>19.3%</u>	<u>72.6%</u>	<u>100%</u>
Total				
N	24	115	664	803
% across sites	<u>3.0%</u>	<u>14.3%</u>	<u>82.7%</u>	<u>100%</u>

Note: Sites differ significantly; chi-square (df = 10) = 32.1, p <.001.

TABLE K-50

Q91 - Condition of Exterior Paint

<u>Site</u>	<u>Peeling</u>	<u>Some Peeling</u>	<u>No Peeling</u>	<u>Total</u>
Windsor				
N	3	23	108	134
% per site	2.2%	17.2%	80.6%	100%
Toronto				
N	-	37	96	133
% per site	-	27.8%	72.2%	100%
Scarborough				
N	5	10	119	134
% per site	3.7%	7.5%	88.8%	100%
Etobicoke				
N	1	21	109	131
% per site	0.8%	16.0%	83.2%	100%
Walpole				
N	8	28	98	134
% per site	6.0%	20.9%	73.1%	100%
Longwoods				
N	19	41	74	134
% per site	<u>14.2%</u>	<u>30.6%</u>	<u>55.2%</u>	<u>100%</u>
Total				
N	36	160	604	800
% across sites	4.5%	20.0%	75.5%	100%
	=====	=====	=====	=====

Note: Sites differ significantly; chi-square (df = 10) = 74.9, $p < .001$.